STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T MASON BUILDING, PO BOX 30028, LANSING MI 48909-7528

ROLAND HARMES, Director

REPLY TO:
JACKSON DISTRICT HEADQUARTERS
301 E LOUIS GLICK HWY
JACKSON MI 49201-1556

April 24, 1995

Mr. Robert Sullivan
Wacker Silicones Corp.
3301 Sutton Road
Adrian, MI 49221

Dear Mr. Sullivan:

Subject: Remedial Investigation of Wacker Facility, Adrian

I have recently been assigned as project manager for sites in Lenawee County. I have been reviewing files for sites in this county to assess the status of the project work. One of these sites in the Wacker Silicones facility.

There appear to have been two areas of concern in the past: 1)an area where buried drums have been removed, and 2)a sludge lagoon that was capped at some point. In addition, there was evidence indicating groundwater contamination from chlorinated solvents which was never fully defined.

Unfortunately, the latest information we have in our files is several years old. I would appreciate it if you could update me on the current status of your investigations into these concerns and what actions you anticipate undertaking in the future. I will look forward to receiving this information. If you have any questions concerning this matter, please feel free to contact me at (517) 780-7932.

Sincerely,

Peter T. Masson
Environmental Quality Analyst
Environmental Response Division

cc: Dowe Parsons, MERA Supervisor

34400 GLENDALE AVENUE
LIVONIA, MICHIGAN 48150
(313) 525-0310

KENNETH W. KRAMER P.E.
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CONSULTANT

ANN ARBOR
BATTLE CREEK
BAY CITY
INDIANAPOLIS
LANSING

March 29, 1989

Mr. Gordon Philbrook
Wacker Silicones Corporation
Tech Center
3301 Sutton Road
Adrian, Michigan 49221-9397

RE: Soil Contamination Investigation
Former Buried Drum Site
Wacker Silicones Property
Sutton Road
Adrian, Michigan
SME Project Number E-12781

Dear Mr. Philbrook:

This letter report presents our findings from the subsurface investigation conducted at the buried drum site on Wacker Silicones' property. In response to your request for an investigation, SME conducted soil borings, collected subsurface soil samples, and arranged for analytical testing of the soil samples.

Boring locations, sampling intervals, and types of analytical tests to be conducted on the soil samples were selected by Wacker Silicones. A discussion of field activities, analytical results, conclusions, and recommendations follows.

FIELD ACTIVITIES

On January 9, 1989, four, 25-foot borings were conducted within the pit where drums had previously been buried (see Figure 1). A Wacker Silicones representative accompanied the SME employees to the site to point out boring locations within the pit.

Drilling was conducted using hollow stem augers. Soil samples were collected with a split spoon sampler using the standard penetration technique (SPT). Beginning at the ground surface, eight split spoon samples were collected from each boring at the following two-foot intervals: 0 to 1.5 feet, 3.5 to 5 feet, 7 to 8.5 feet, 10.5 to 12 feet, 14 to 15.5 feet, 17.5 to 19 feet, 21 to 22.5 feet, and 23.5 to 25 feet.

The boring logs are appended. The soil samples were interpreted to indicate subsurface conditions of predominantly fine to medium sand turning to fine sand with depth. No groundwater was encountered in B-1. Groundwater was encountered in B-2, B-3, and B-4 at depths of 24.5 to 25 feet.

Strict decontamination procedures were followed between each boring and prior to collecting each soil sample. Augers were steam cleaned prior to conducting each boring. Before each sample, the split spoon sampler was cleaned with a trisodium phosphate (TSP) and distilled water wash followed by a distilled water rinse. All borings were backfilled with drill cuttings.

ANALYTICAL RESULTS

Laboratory analyses were conducted by ENCOTEC in Ann Arbor, Michigan. Soil samples were kept cool until delivery to ENCOTEC on January 10, 1989. Each of the 32 soil samples was analyzed discretely for trimethylsilanol and DNR Scan 1 Purgeable Halocarbons using the gas chromatography (GC) technique. It was established through Wacker Silicones and ENCOTEC that trimethyl silanol can be analyzed during the same GC scan as the Scan 1 halocarbons.

The analytical results are appended. Table 1 presents a summary of the analytical results.

If you have any questions regarding this report or require assistance with further site work, please feel free to contact us. We appreciate the opportunity to serve you during this phase of your investigation.

Sincerely,

SOIL AND MATERIALS ENGINEERS, INC.

Grant Kolb
Grant Kolb
Senior Hydrogeologist

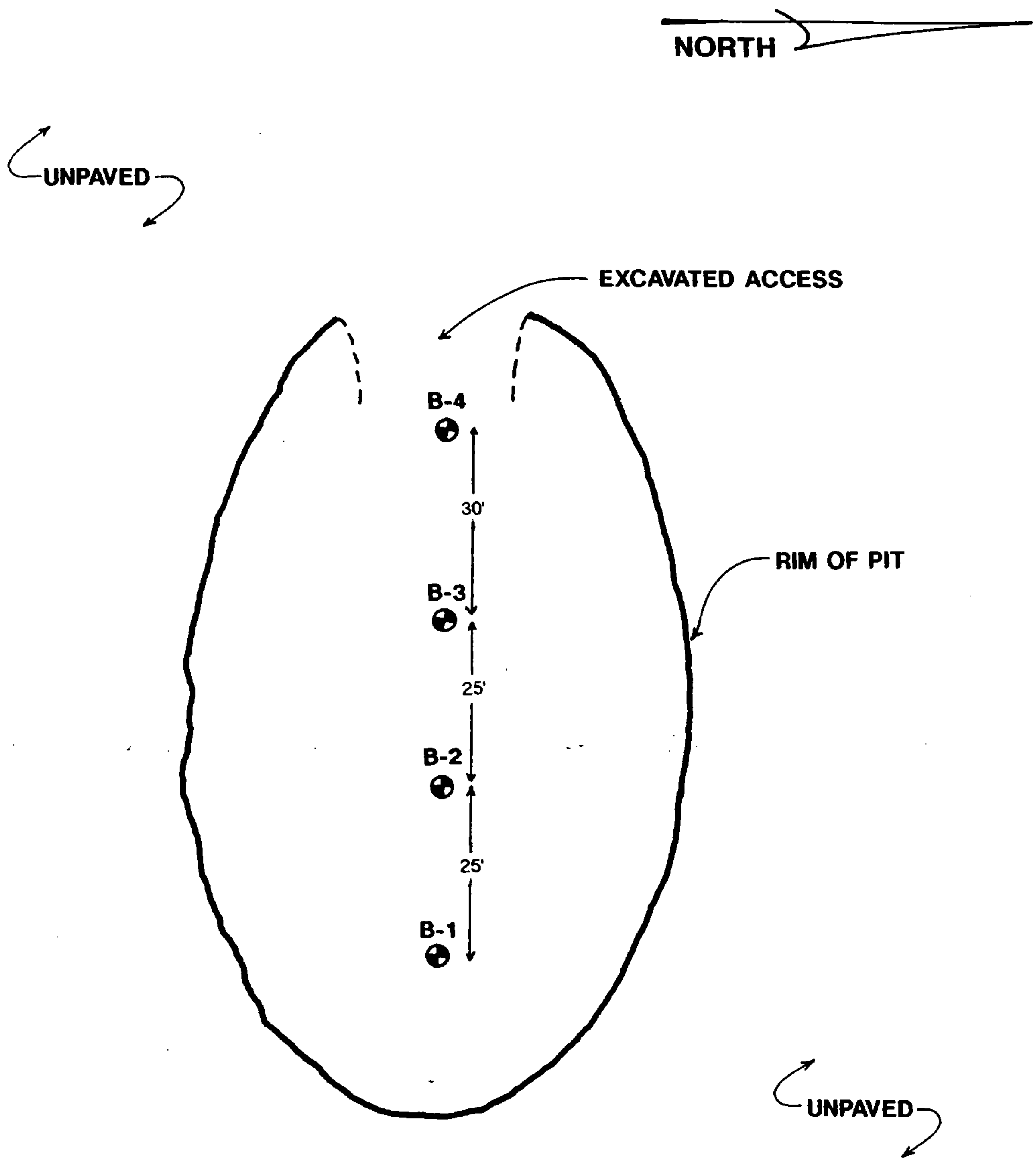
Cheryl Kehres-Dietrich
Cheryl Kehres-Dietrich
Project Hydrogeologist

TABLE I

Summary of Analytical Results
Wacker Silicones
SME Project No. E-12781

	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
Boring 1								
Trimethylsilanol	LTD	LTD	LTD	LTD	LTD	LTD	LTD	LTD
Tetrachlorethene	Trace	2.1	3.6	0.7	2.0	1.7	1.4	0.5
1, 1, 1 Trichloroethane	Trace	LTD	LTD	LTD	LTD	LTD	LTD	LTD
Trichloroethene	LTD	LTD	Trace	LTD	LTD	LTD	LTD	LTD
Boring 2								
Trimethylsilanol	0.24	0.24	0.18	0.18	0.12	0.20	0.22	LTD
Tetrachlorethene	0.5	3.2	1.3	0.5	1.2	Trace	LTD	0.5
Trichloroethene	Trace	LTD	Trace	Trace	LTD	LTD	LTD	LTD
Vinyl Chloride	LTD	Trace	LTD	LTD	LTD	LTD	LTD	LTD
Boring 3								
Trimethylsilanol	0.06	0.12	0.18	0.16	0.26	0.30	0.10	LDT
Tetrachlorethene	Trace	0.7	Trace	LTD	LTD	LTD	LTD	LTD
Boring 4								
Trimethylsilanol	LTD	LTD	LTD	LTD	0.06	LTD	LTD	0.08

LTD = Less Than Detectable
Trace = Present at level less than detection limit
Values reported in mg/kg



NOTE: PIT APPROXIMATELY 12 - 15' IN DEPTH.

Date 2/17/89 Drawn By LB Scale 1"= APPROX 25' Job E-12781	ANN ARBOR BATTLE CREEK BAY CITY LANSING LIVONIA	soil and materials engineers, inc	**SOIL BORING LOCATION DIAGRAM** **WACKER SILICONES** **ADRIAN, MICHIGAN**

Figure No. 1

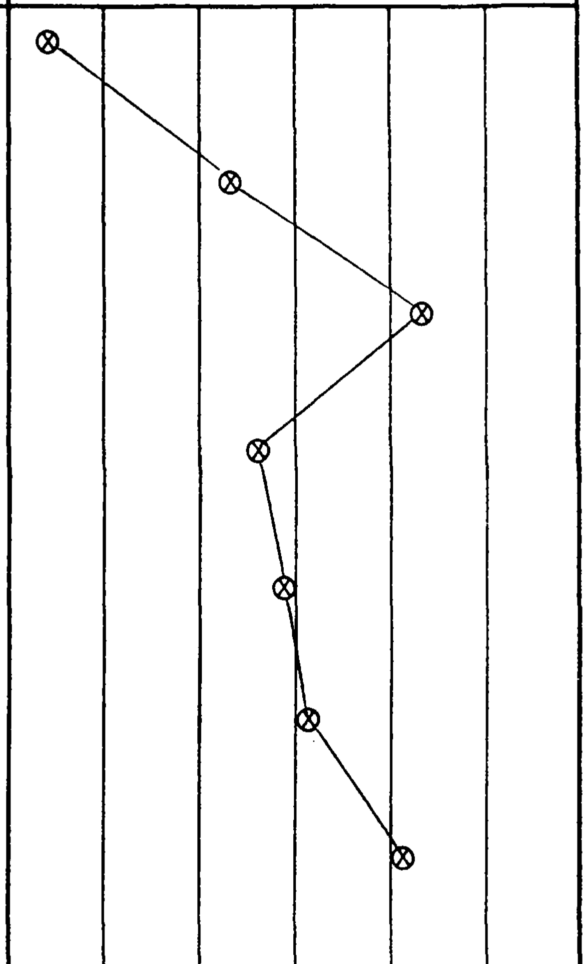
BORING LOG NO. 1

OWNER	ARCHITECT / ENGINEER
Wacker Silicones	
LOCATION	PROJECT NAME Soil Contamination Investigation
Sutton, Road - Adrian, MI	Buried Drum Site

LEGEND: STANDARD PENETRATION, "N" BLOWS/FT; NATURAL WATER CONTENT, %; ATTERBERG LIMITS PL % LL %; UNCONFINED COMPRESSIVE STRENGTH tsf; *CALIBRATED HAND PENETROMETER STRENGTH tsf

SCALE: *○○ 1 2 3 4 5 tsf; ● ⊗ 10 20 30 40 50 %.N

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
				SURFACE ELEVATION	
1	SS				
2	SS		5		
3	SS				
4	SS		10		
5	SS		15	Fine to Medium Sand Turning to Fine Sand at Approximately 9' Brown - Moist	
6	SS				
7	SS		20		
8	SS		25		
				End of Boring	
				NOTES: No groundwater was encountered during drilling.	
				Trace of clay to 8.5'	



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

None WHILE SAMPLING OR WHILE DRILLING

_____ IMMEDIATELY AFTER COMPLETION

_____ _____ AFTER COMPLETION

BORING STARTED	1/9/89
BORING COMPLETED	1/9/89

RIG: 72 DRAWN BY: CB

FOREMAN: JH APPROVED: CKD

JOB: E12781 SHEET: 1 of 1

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

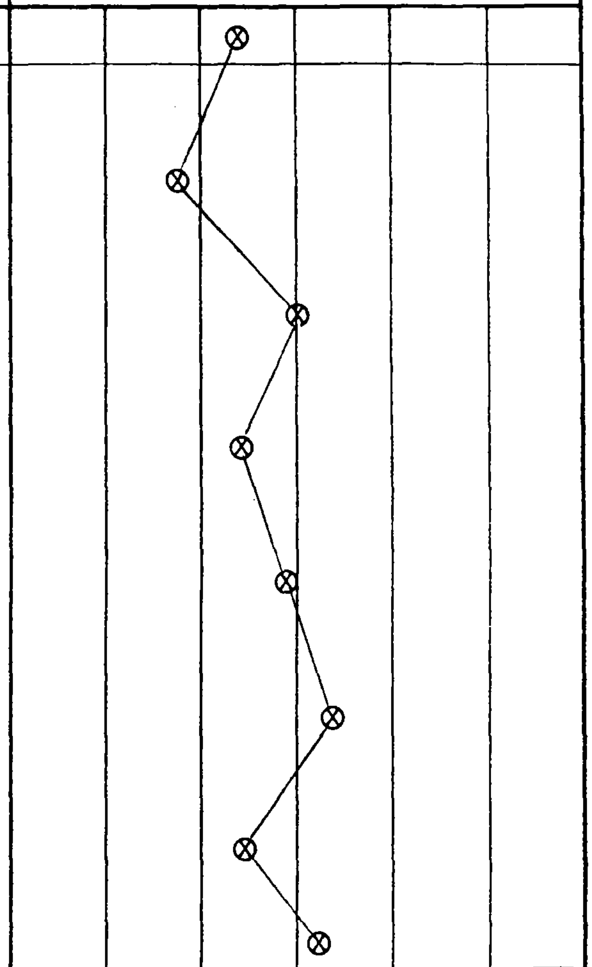
OWNER	ARCHITECT / ENGINEER
Wacker Silicones	
LOCATION	**PROJECT NAME** Soil Contamination Investigation
Sutton Road - Adrian, MI	Buried Drum Site

LEGEND

- STANDARD PENETRATION, N BLOWS/FT
- NATURAL WATER CONTENT, %
- ATTERBERG LIMITS PL% LL%
- UNCONFINED COMPRESSIVE STRENGTH tsf
- *CALIBRATED HAND PENETROMETER STRENGTH tsf

SCALE: 1 2 3 4 5 tsf / 10 20 30 40 50 %, N

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
				SURFACE ELEVATION	
1	SS			Fine to Coarse Sand - Trace Gravel - Brown - Moist	
2	SS		5	Fine to Medium Sand Turning to Fine Sand at 8' - Brown - Moist	
3	SS				
4	SS		10		
5	SS		15		
6	SS				
7	SS		20		
8	SS		25		
				End of Boring	
				NOTE: Moist turning to wet at 24.5'	



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

24.5' WHILE SAMPLING OR WHILE DRILLING
____ IMMEDIATELY AFTER COMPLETION
____ ____ AFTER COMPLETION

BORING STARTED	1/9/89
BORING COMPLETED	1/9/89

RIG: 72 DRAWN BY: CB
FOREMAN: JH APPROVED: CKD
JOB: E12781 SHEET: 1 of 1

NOTE: Boring backfilled with natural soils unless otherwise noted.

sme soil and materials engineers, inc

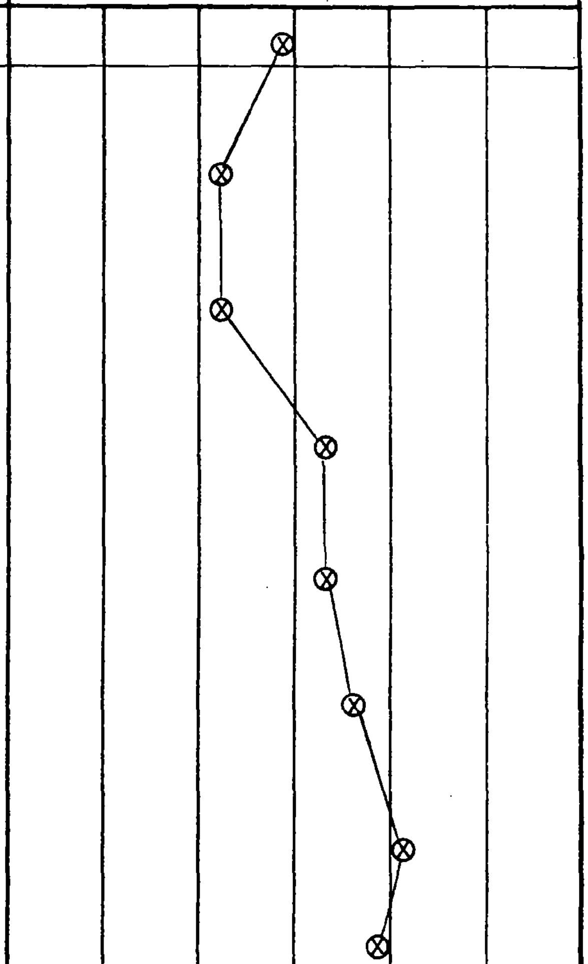
BORING LOG NO. 3

OWNER	ARCHITECT / ENGINEER
Wacker Silicones	
LOCATION	PROJECT NAME Soil Contamination Investigation Buried Drum Site
Sutton Road - Adrian, Michigan	

LEGEND
- ⊗ STANDARD PENETRATION, "N" (BLOWS / FT)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ PL % LL %
- ○ UNCONFINED COMPRESSIVE STRENGTH tsf
- *○ CALIBRATED HAND PENETROMETER STRENGTH tsf

SCALE
- *○○ 1 2 3 4 5 tsf
- ● ⊗ 10 20 30 40 50 %.N

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
				SURFACE ELEVATION	
1	SS			Fine to Coarse Sand - Brown With Red Staining - Dry	
2	SS		5	Fine to Medium Sand Turning to Fine Sand at Approximately 9' - Brown, Red Staining to 5.0' - Moist	
3	SS				
4	SS		10		
5	SS		15		
6	SS				
7	SS		20		
8	SS		25		



End of Boring

NOTES:

Trace of gravel observed at 3½' to 5'

Moist turning to wet at 25'

NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

25' WHILE SAMPLING OR WHILE DRILLING

____ IMMEDIATELY AFTER COMPLETION

____ ____ AFTER COMPLETION

BORING STARTED	1/9/89
BORING COMPLETED	1/9/89

RIG: 72 DRAWN BY: CB

FOREMAN: JH APPROVED: CKD

JOB: E12781 SHEET: 1 of 1

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

BORING LOG NO. 4

OWNER	ARCHITECT / ENGINEER
Wacker Silicones	
LOCATION	**PROJECT NAME** Soil Contamination Investigation
Sutton Road - Adrian, MI	Buried Drum Site

LEGEND

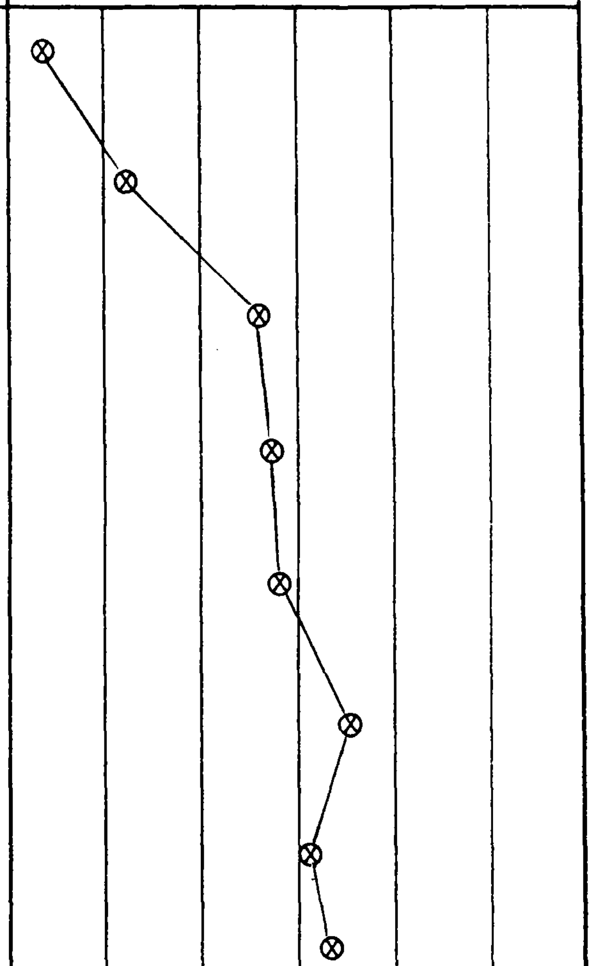
- ⊗ STANDARD PENETRATION, "N" BLOWS / FT
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (PL % / LL %)
- ○ UNCONFINED COMPRESSIVE STRENGTH tsf
- ★○ CALIBRATED HAND PENETROMETER STRENGTH tsf

SCALE

★○○ 1 2 3 4 5 tsf

●⊗ 10 20 30 40 50 %, N

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS / FT³
				SURFACE ELEVATION	
1	SS			Fine to Medium Sand Turning to Fine Sand at Approximately 13' - Brown - Moist	
2	SS		5		
3	SS				
			10		
4	SS				
5	SS		15		
6	SS				
			20		
7	SS				
8	SS				
			25	End of Boring NOTE: Moist turning to wet at 25'	



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

25' WHILE SAMPLING OR WHILE DRILLING

____ IMMEDIATELY AFTER COMPLETION

____ ____ AFTER COMPLETION

BORING STARTED	1/9/89
BORING COMPLETED	1/9/89

RIG: 72 DRAWN BY: CB

FOREMAN: JH APPROVED: CKD

JOB: E12781 SHEET: 1 of 1

NOTE: Boring backfilled with natural soils unless otherwise noted.

sme soil and materials engineers, inc

ENCOTEC
ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION

3985 RESEARCH PARK DRIVE
ANN ARBOR, MICHIGAN 48108
313/761-1389

RECEIVED
FEB 27 1989

February 21, 1989

Ms. Cheryl Kehres-Dietrich
SME
34400 Glendale
Livonia, MI 48150

Dear Cheryl:

Enlcosed are the data obtained on the soil samples from the Wacker Silicones project. The delay in producing this data resulted from the time required to develop an analytical program for the trimethylsilanol. We were unable to locate a source of pure material to use as a standard, and thus had to quantify the results based on the response factor of an internal standard. The internal standard selected for this purpose was terbutyl alcohol, which has the same tetrahedryl structure as trimethylsilanol, the only difference being a central atom of silicon rather than carbon. If you or your client have any questions in regards to these data, please feel free to contact me.

Very truly yours,

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION

John E. Schenk, Ph.D., P.E.
Vice President

JES/clk

Enclosure

#25801

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME-Wacker Silicones

PROJECT NO.: 25801

SAMPLE TYPE: Soil

REPORT DATE: 2/20/89

SAMPLE NAME		B-1,S-1	B-1,S-2	B-1,S-3	B-1,S-4	B-1,S-5
SAMPLE DATE		01/09/89	01/09/89	01/09/89	01/09/89	01/09/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26016	26017	26018	26019	26020
Trimethylsilanol	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME

PROJECT NO.: 25801

SAMPLE TYPE: Soil

REPORT DATE: 2/20/89

SAMPLE NAME		B-1,S-6	B-1,S-7	B-1,S-8	B-2,S-1	B-2,S-2
SAMPLE DATE		01/09/89	01/09/89	01/09/89	01/09/89	01/09/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26021	26022	26023	26024	26025
Trimethylsilanol	mg/kg	<0.05	<0.05	<0.05	0.24	0.24

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME

PROJECT NO.: 25801

SAMPLE TYPE: Soil

REPORT DATE: 2/20/89

SAMPLE NAME		B-2,S-3	B-2,S-4	B-2,S-5	B-2,S-6	B-2,S-7
SAMPLE DATE		01/09/89	01/09/89	01/09/89	01/09/89	01/09/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26026	26027	26028	26029	26030
Trimethylsilanol	mg/kg	0.18	0.18	0.12	0.20	0.22

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME PROJECT NO.: 25801
SAMPLE TYPE: Soil REPORT DATE: 02/20/89

SAMPLE NAME		B-2,S-8	B-3,S-1	B-3,S-2	B-3,S-3	B-3,S-4
SAMPLE DATE		01/09/89	01/09/89	01/09/89	01/09/89	01/09/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26031	26032	26033	26034	26035
Trimethylsilanol	mg/kg	<0.05	0.06	0.12	0.18	0.16

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME

PROJECT NO.: 25801

SAMPLE TYPE: Soil

REPORT DATE: 02/20/89

SAMPLE NAME		B-3,S-5	B-3,S-6	B-3,S-7	B-3,S-8	B-4,S-1
SAMPLE DATE		01/09/89	01/09/89	01/09/89	01/09/89	01/09/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26036	26037	26038	26039	26040
Trimethylsilanol	mg/kg	0.26	0.30	0.10	<0.05	<0.05

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME
PROJECT NO.: 25801
SAMPLE TYPE: Soil
REPORT DATE: 02/20/89

SAMPLE NAME		B-4,S-2	B-4,S-3	B-4,S-4	B-4,S-5	B-4,S-6
SAMPLE DATE		01/09/89	01/09/89	01/09/89	01/09/89	01/09/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26041	26042	26043	26044	26045
Trimethylsilanol	mg/kg	<0.05	<0.05	<0.05	0.06	<0.05

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: SME PROJECT NO.: 25801
SAMPLE TYPE: Soil REPORT DATE: 02/20/89

SAMPLE NAME		B-4,S-7	B-4,S-8			
SAMPLE DATE		01/09/89	01/09/89			
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		26046	26047			
Trimethylsilanol	mg/kg	<0.05	0.08			

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-1
ENCOTEC Number: 26016
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/18/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	J	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	J	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-2
ENCOTEC Number: 26017
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/18/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	2.1	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-3
ENCOTEC Number: 26018
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/18/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	3.6	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	J	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-4
ENCOTEC Number: 26019
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/18/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	0.7	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-5
ENCOTEC Number: 26020
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	2.0	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-6
ENCOTEC Number: 26021
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	1.7	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-7
ENCOTEC Number: 26022
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	1.4	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-1, S-8
ENCOTEC Number: 26023
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	0.5	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-1
ENCOTEC Number: 26024
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	0.5	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	J	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-2
ENCOTEC Number: 26025
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	3.2	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	J	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-3
ENCOTEC Number: 26026
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	1.3	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	J	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-4
ENCOTEC Number: 26027
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/19/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	0.5	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	J	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-5
ENCOTEC Number: 26028
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/16/89
Date Analyzed: 1/20/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	1.2	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-6
ENCOTEC Number: 26029
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	J	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-7
ENCOTEC Number: 26030
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-2, S-8
ENCOTEC Number: 26031
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/20/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	0.5	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-1
ENCOTEC Number: 26032
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/20/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	J	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-2
ENCOTEC Number: 26033
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/20/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	0.7	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-3
ENCOTEC Number: 26034
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	J	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-4
ENCOTEC Number: 26035
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/25/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-5
ENCOTEC Number: 26036
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/25/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-6
ENCOTEC Number: 26037
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/25/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-7
ENCOTEC Number: 26038
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/25/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-3, S-8
ENCOTEC Number: 26039
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-1
ENCOTEC Number: 26040
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-2
ENCOTEC Number: 26041
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-3
ENCOTEC Number: 26042
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/23/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-4
ENCOTEC Number: 26043
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-5
ENCOTEC Number: 26044
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-6
ENCOTEC Number: 26045
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
cis-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
trans-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
cis-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
trans-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

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ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: SME
Project Number: 25801
Method: Mich DNR Scan 1
Report Date: February 15, 1989

Sample: B-4, S-7
ENCOTEC Number: 26046
Sample Date: 1/9/89
Date Received: 1/10/89
Date Extracted: 1/19/89
Date Analyzed: 1/24/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/kg	U	0.4
Bromoform	75-25-2	mg/kg	U	0.4
Bromomethane	74-83-9	mg/kg	U	2.0
Carbon Tetrachloride	56-23-5	mg/kg	U	0.4
Chlorobenzene	108-90-7	mg/kg	U	0.4
Chloroethane	75-00-3	mg/kg	U	2.0
Chloroform	67-66-3	mg/kg	U	0.4
Dibromochloromethane	124-48-1	mg/kg	U	0.4
1,1-Dichloroethane	75-34-3	mg/kg	U	0.4
1,2-Dichloroethane	107-06-2	mg/kg	U	0.4
1,1-Dichloroethene	75-35-4	mg/kg	U	0.4
<u>cis</u>-1,2-Dichloroethene*	540-59-0	mg/kg	U	0.4
<u>trans</u>-1,2,-Dichloroethene*	156-60-5	mg/kg	U	0.4
1,2-Dichloropropane	78-87-5	mg/kg	U	0.4
<u>cis</u>-1,3-Dichloropropene	10061-01-5	mg/kg	U	0.4
<u>trans</u>-1,3-Dichloropropene	10061-02-6	mg/kg	U	0.4
Methylene Chloride	75-09-2	mg/kg	U	0.4
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	U	0.4
Tetrachloroethene	127-18-4	mg/kg	U	0.4
1,1,1-Trichloroethane	71-55-6	mg/kg	U	0.4
1,1,2-Trichloroethane	79-00-5	mg/kg	U	0.4
Trichloroethene	79-01-6	mg/kg	U	0.4
Trichlorofluoromethane	75-69-4	mg/kg	U	0.4
Vinyl Chloride	75-01-4	mg/kg	U	0.4

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

LWCU Lenawee Co. Gen file

July 30, 1987

TO: Robert Babcock, Environmental Quality Analyst, Jackson District
Surface Water Quality Division

FROM: Ronald D. Kooistra, Jackson District Supervisor RDK
Environmental Response Division

SUBJECT: Wacker Silicones Corporation

In response to your 7/30/87 request for comment on Wacker Silicones Corporation 7/24/87 letter proposing to discharge cooling water pond sediments onto the River Raisin flat lands, I submit the following:

1. A wetlands and/or flood plain permit may be necessary.

2. Only EP tox data is provided. Are there other potentially polluting materials or concentration levels?

3. We would recommend that the Land Application Unit be contacted to review/approve this "sludge" application under the "PERM" program. If they don't handle it, disposal in a type II or possibly type III landfill (with neutral leach test data) would be applicable.

RDK:lt

cc: Tom Work
Synthia Noble, WMD w/copy of 7/24/87 letter
Dan O'Neil, WMD w/copy of 7/24/87 letter

31 Reicks

RECEIVED
APR 11 1986
JACKSON DISTRICT
SWQD GWQD

Dave Dennis
Kooistra
3097 Lenawee Co.
SWS Silicones

RECEIVED
APR 04 1986
COMPLIANCE 2

March 31, 1986

TO: Bill Shaw, Permits Section

FROM: Linn Duling, Toxic Chemical Evaluation Section

SUBJECT: SWS Silicones Organics Loading to the River Raisin

We have been asked by Robert Babcock (memo dated 2-11-86) to evaluate the toxicity of various chemicals found in two (2) unpermitted groundwater discharges to the River Raisin as a result of past practices by the subject facility. Based upon our evaluation, we have the following comments:

1. The presence of 1,1,1-trichloroethane in both the seepage pond/evaporation area discharge and the buried barrel site discharge does not change our previous WQBEL of 3.9 mg/l as a 30-day average concentration and 5.3 mg/l as a daily maximum (TCES memo dated 2-6-86).

2. The seepage pond/evaporation area discharge contains the following chemicals at the concentrations indicated. For comparison, the Rule 57(2) allowable level is also indicated. Five of the thirteen chemicals exceed their respective Rule 57(2) allowable level (no dilution with the receiving stream was considered).

Chemical	Discharge Conc. (ug/l)	Rule 57(2) A.L. (ug/l)
Ethanol	3000	I.D.
Methylene Chloride*	15	430
Acetone	55	320
1,1-Dichloroethane	588	I.D.
1,2-Dichloroethane*	23	560
trans,1,2-Dichloroethylene	220	90
1,1,1-Trichloroethane	31	120
trans,Amyl Alcohol	1310	I.D.
Trichloroethylene*	300	94
Tetrachloroethylene*	7190	20
Toluene	30	100
Benzene*	10	24
1,1,2-Trichloroethane*	65	64

* Chemical considered to be carcinogenic
I.D. Insufficient toxicity data to derive Rule 57(2) A.L.

File

SWS Silicones Corporation

3301 SUTTON ROAD • ADRIAN, MICHIGAN 49221-9397 • TELEPHONE (517) 263-5711

RECEIVED
DEC 19 1985
JACKSON DISTRICT

December 18, 1985

State of Michigan
Department of Natural Resources
Surface Water Quality Division,
Jackson District
Mr. Steve Eldredge, District Supervisor
4th Floor, State Office Building
301 E. Louis Glick Hwy.
Jackson, MI 49201

Re: NPDES Permit MI0026034

Dear Mr. Eldredge:

This letter is in response to your letter to us on September 30, 1985.

We have sampled the observation wells (in November) around the old buried barrels area (the M wells), and around the old evaporation pond area (the OW wells). The attached table summarizes the results.

Note that we removed the drums from the old buried barrels area in November, 1984, and that we removed the water from the old evaporation pond, and fixed and capped the pond in August to October, 1982.

We trust that this information will allow you to complete the reissuance process for our NPDES Permit MI0026034.

If you have any questions, please contact me at the number listed above, extension 361.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 85-212, certified

cc: J. Calamungi
G. F. Lengnick
T. J. Sayers

xc: B. Shaw, Permits

analyte	M Wells		OW (perched) Wells		OW (acquifer) Well	
	AVER. mg/l	#/day	AVER. mg/l	#/day	mg/l	#/day
ethanol	-	-	3.000	0.083	ND	-
methylene chloride	-	-	0.015	0.0004	ND	-
acetone	-	-	0.055	0.0015	tr	-
1,1 dichloroethane	0.017	0.001	0.588	0.0160	tr	-
1,2 dichloroethane			0.023	0.0006	ND	-
t,1,2 dichloroethylene	0.132	0.001	tr	-	0.220	0.005
1,1,1 trichloroethane	0.333	0.027	0.030	0.0008	0.035	0.0007
t-amyl alcohol	-	-	1.310	0.0366	ND	-
trichloroethylene	0.310	0.025	ND	-	0.300	0.006
tetrachloroethylene	0.270	0.022	0.005	0.0001	16.540	0.352
toluene	-		tr	-	0.030	0.0006
benzene	-		0.015	0.0004	0.005	0.0001
1,1,2 trichloroethane	-		0.098	0.0027	0.025	0.0005
Totals	1.062	0.076	5.139	0.1421	17.155	0.3649

SWS
12/18/85

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

RECEIVED
FEB 7 1985
JACKSON DISTRICT
SWQD GWQD

January 29, 1985

TO: ~~Ron Kooistra, Supervisor, Jackson Compliance District~~
Groundwater Quality Division

FROM: Daniel O. Cummins, Geologist, Lansing Compliance District
Groundwater Quality Division

DOC

SUBJECT: SWS Silicones Black Pond - Lenawee County

I have reviewed the SWS Silcones (SWS) materials related to the "Black Pond". The information indicates a contamination problem similar to the Buried Barrels site. Contaminants are leaching from an existing source and entering a dual aquifer system, similar to the one at the Buried Barrels site. Both aquifers appear to discharge to the river or associated wetlands. Flow rates determined by SWS are acceptable.

The contamination at this site is at higher concentrations then the Buried Barrel site. The numbers provided by SWS regarding loading of contaminants to the river are incorrectly characterized as "worst" case. Contaminant concentrations used in the calculations to determine loading were only average values and not highest observed concentrations. I suggest using the highest parameter values for wells OW-1S, OW-4S, OW-1D, and OW-4D. The highest concentrations associated with these wells would be indicative of 'worst' case conditions.

Though there was an agreement allowing SWS to "neutralize" and cap the pond, I do not feel this was an adequate solution. I am unclear as to how lime will neutralize organic chemicals. Also, I am interested in the method of construction and design of the clay cap. Finally, capping the lagoon will not prevent leachate generation if the bottom of the lagoon is within the saturated zone of the perched aquifer. The provided data does not allow for confirmation of this possibility.

I recommend additional information be obtained regarding the depth of the lagoon in relation to the highest elevation of the perched water table. Also, If as-built drawings and technical certification (soil classification, compaction, permeability, and thickness) of the clay cap are not available, efforts should be made to obtain such data.

DOC:sl

cc: Steve Eldridge, Jackson SWQD

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

245 - Lenawee Co
SWS Silicones Co
GW Cleanup file

December 12, 1984

TO: Valerie S. Harris
Environmental Enforcement Division

FROM: Robert F. Babcock, Jackson District Robert F. Babcock
Surface Water Quality Division

SUBJECT: SWS Silicones Corporation
Buried Barrel Cleanup

Summary

The SWS Silicones Corporation uncovered, evaluated, and staged for removal approximately 85 buried barrels of wastes and approximately 140 cubic yards of contaminated soils between November 13, 1984 and November 19, 1984. Barrels were found in various stages of decomposition: highly corroded with only top and bottom rings to some with very little apparent corrosion with original fluid wastes inside. Two soil samples and one drum content sample taken by Department staff showed the following identified groundwater contaminants to be present: trichloroethene and tetrachloroethene.

None of the highly volatile and reactive chlorosilanes were found (attachment #1 - Material Data Safety Sheet). Forty-five drums and their contents were over-packed due to fluid contents remaining, four of which contained highly concentrated solvents such as xylene, methanol and mineral spirits. No highly concentrated chlorinated solvents were found in the recovered barrels.

Report

O. H. Materials, Inc. arrived at SWS Silicones Corporation on November 12, 1984 and set up their equipment and treatment system on November 13, 1984.

On November 14, 1984, the writer along with Ms. Cheryl Howe (Hazardous Waste-Permits), Robert Basch (Hazardous Waste - Compliance), and Thomas Julien (Air Quality Division - Compliance) met with Mr. Philbrook of the company and Messrs. Miller and Meeker of O. H. Materials, Inc. (the cleanup contractor).

After discussion of the proposed treatment system and plan of action and safety precautions (attachment #2 - Site Safety Plan) with the contractor, staff (except Mr. Julien) stayed to view the backhoe remove a portion of the soil covering the buried barrels, approximately 30 feet by 5 feet by 2 feet, which extended from the northwest portion of the area diagonally to the southeast.

On November 15, 1984, I received a telephone call from Mr. Philbrook reporting:

- 10-15 remnants of drums were uncovered but none were intact
- Estimated that they were approximately 10% done
- Only water as fluid contents in barrels so far
- The chlorosilane treatment system may not need to be used
- The company does not want me taking photographs and offered to take photographs and supply the Department with copies. I agreed with the company's request concerning photographs with the promise that the Department receive copies which clearly show the barrels being uncovered and staged at the site.

Also, the photographs must be identified as to who took them and showing date and time taken.

On November 16, 1984, I went to the site and split two soil samples and one drum content sample with the company (table 1). The following was observed:

- Overpack recovery drums were being staged for putting old drums with fluid contents into them.
- Fluid contents sloshed out of a hole on the top of an old drum as it was being manipulated by the equipment.
- No additional barrels were being uncovered.
- Samples, analysis and characterizations as to hazardousness were being performed by the company.
- The soil was of a sand and gravel nature.

On November 19, 1984, Mr. Philbrook telephoned a report as follows:

- The O. H. Materials, Inc. work is completed and they are preparing to leave the site.
- Approximately 85 drums were found, 35 of which required overpacks.
- Did not find chlorosilanes or use on-site treatment system.
- Removed approximately 100 cubic yards of trench soil (approximately two feet in depth).
- No hazardous wastes, as yet, although analysis and characterizations continuing.

On December 10, 1984, I telephoned Mr. Philbrook and learned the following:

- Approximately 140 cubic yards of soils (approximately two feet from bottom of trench) and 45 overpacked barrels will be disposed of.
- 40 shells of barrels - crushed and in various stages of decomposition will be disposed of.
- Four barrels of solvents were found containing xylene, methanol and mineral spirits - although no concentrated chlorinated solvents were found.
- Reports of analysis were received December 7, 1984 which " . . . showed a lot of little blips in the soils leachate . . .".
- Five photographs will be sent to the Department with information as requested.
- Site wastes (soils, crushed barrels and overpacked barrels) are proposed to be neutralized and solidified as hazardous wastes and disposed of in a Type I landfill in Wayne County beginning December 13, 1984.

RFB:sdl

cc: R. Kooistra
S. Eldredge
F. Baldwin

TABLE 1

S.W.S. SILICONES CORP. BURIED BARREL SITE

DNR Environmental Laboratory Analyses
for Scan 1 - Purgeable Halocarbons

SAMPLE NO.	DESCRIPTION	DATE	TIME	DETECTION LIMIT	RESULTS
1	drum pit soils	November 16, 1984	11:15 A.M.	4.8 ug/kg	None detected
2	drum pit soils	November 16, 1984	11:15 A.M.	4.9 ug/kg	5.2 ug/kg trichloroethene 40.0 ug/kg tetrachloroethene
3	water blank (SWS deionized water)	November 16, 1984	1:30 P.M.	1.0 ug/l	None detected
4	drum contents (silicone oil)	November 16, 1984	2:30 P.M.	Qualitative	1,1,1 - trichloroethane trichloroethene tetrachloroethene
5	soil composite	November 17, 1984	6:00 P.M.	2.9 ug/kg	13 ug/kg 1,2-dichloroethene 240 ug/kg chloroform 17 ug/kg 1,1,1-trichloroethane 740 ug/kg trichloroethene 210 ug/kg tetrachloroethene 4200 ug/kg chlorobenzene
6	water blank (SWS deionized water)	November 19, 1984	1:45 P.M.	1.00 ug/l	1.1 ug/l chlorobenzene

SWS Silicones Corporation

ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

RECEIVED

DEC 12 1984

December 11, 1984

245-Lenawee Co
SWS Silicones Co
GW Cleanup file

Mr. Steve Eldredge
State of Michigan
Department of Natural Resources
Jackson District Supervisor
Surface Water Quality Division
4th Floor, State Office Building
301 E. Louis B. Glick Highway
Jackson, Michigan 49201

Re: Buried Barrels Removal

Dear Mr. Eldredge:

This letter is to confirm that O. H. Materials Co. has removed the buried drums, and about two feet of contaminated soil from the bottom of the trench, during the period of November 12 to 19, 1984.

As you already know, due to the visits of Robert Babcock, Robert Basch, and others from the Michigan Department of Natural Resources, we did not have to use the chlorosilane treating system.

The material for disposal is about 140 yards of potentially contaminated soil, 45 partially damaged drums which are in 67-gallon "over-pac recovery" drums, and about 40 crushed, empty drums. It is planned to send all of this material to Chem-Met Services for lime fixation/solidification and eventual disposal in an approved secure hazardous waste landfill.

As per your letter of July 26, 1984, the soil was tested for ignitability, corrosivity and reactivity; all results were negative. Traces of chlorinated hydrocarbons were detected by the leachate test, and for that reason, we have decided to send the soil to Chem-Met Services.

The drum waste is mostly liquid siloxanes, soil, water, silicone gum, and cured silicone rubber. There are only four drums which contain some solvents, which had a flashpoint requiring a "D001" designation. These four drums also contained silicones and other ingredients; in other words, no "pure" solvent drums were found. Also, no chlorinated solvents were found in any of the drums; although, as mentioned above, traces of chlorinated hydrocarbons were detected in the soil. The four drums are described as follows:

1. A Wacker-Chemie 20-gallon drum, which contains about 5 gallons of aliphatic and aromatic solvents (about 85% solvents).

xc: V. Harris
R. Kooistra

2. A Wacker-Chemie 10-gallon drum, which contains about 5 gallons of xylene and aliphatic solvents (about 74% solvents).

3. A heavy-duty 55-gallon drum, which contains about 5 gallons of methanol/water solution.

4. A Wacker-Chemie 20-gallon drum, which contains about 8 gallons of liquid (about 10% xylene, balance water and silicones).

While not clearly classifiable as RCRA hazardous wastes, as a precaution, all of the remaining drums are also being sent to Chem-Met Services.

We expect to have the waste removed around December 13-14, 1984. Mr. Robert Basch has agreed to this disposal during a telephone call on December 11, 1984.

If you have any questions or comments, please do not hesitate to contact us.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 84-240, certified

cc: R. Basch, MDNR; certified
J. Calamungi
G. F. Lengnick
T. J. Sayers
G. L. Ford

OHM
THE ENVIRONMENTAL SERVICES COMPANY

O.H. MATERIALS CO.
Michigan Division
809 Freeman, S.W.
Grand Rapids, MI 49503
Phone. 616-456-8571
800-537-9540 (24 hr)
800-537-5660 (in Ohio)
Telex. 298248 OHMI UR (RCA)

October 23, 1984

RECEIVED
OCT 26 1984
JACKSON DISTRICT
SWQD

RECEIVED
OCT 24 1984
SWQD COMPLIANCE 2

Mr. Del Rector
Hazardous Waste Division
Department of Natural Resources
P.O. Box 30038
Lansing, Michigan 48909

RE: On site Material Handling - SWS Silicones

Dear Mr. Rector:

I would like to confirm O.H. Materials' (OHM) understanding of the Department of Natural Resources position on the above referenced matter. I am basing our understanding on conversations I have had with Mr. Al Howard and Mr. Robert Basch of your staff.

Background: (OHM) submitted a proposal to excavate buried 55 gallon drums, and if necessary, process the liquid contents of said drums.

The proposal called for injecting liquid chlorosilane material into a circulating stream of water with the aid of a venturi. The stream of water (ph adjusted to 11 with 50% caustic) is to be circulated from the storage vessel through the ancillary piping at a rate of 125 gallons per minute. The chlorosilane liquid is to be aspirated into the circulating water stream at a rate of 12.5 gallons per minute. Ultimately, the water and processed chlorosilane will be transported to a licensed hazardous waste disposal facility for solidification and disposal.

The aforementioned proposal was reviewed and approved by persons from the Department of Natural Resources earlier this year. The review process included discussions regarding the need for state permits for the contemplated activity.

OHM understands, and through this letter, confirms that the Department of Natural Resources had determined that no permits are required for the proposed temporary activity. Specifically, we understand that the staff of the Air Quality Division has determined that the proposed activity requires neither a permit to install, nor a permit to operate, pursuant to 1965 PA 348. Furthermore, we understand that the staff of the Hazardous Waste Division has determined that neither a permit to construct, nor a permit to operate is required, pursuant to 1979 PA 64 as amended.

OHM understands that prior to actual operation of the proposed processing equipment, the appropriate staff from the Department of Natural Resources will inspect the equipment.

Based upon our understanding, as above expressed, OHM is prepared to proceed with this project, as proposed, unless otherwise advised.

Our anticipated starting date is November 5, 9184. We will advise you regarding any changes to this timetable as necessary.

Please contact me without delay if you have any questions, or if the content of this letter is not consistent with the Department of Natural Resources position on this matter.

Very truly yours,

James C. Miller
Manager
Michigan Division

JCM/csb

pc: G. Philbrook - SWS
I. Kane
S. Smith
R. Basch - MDNR
G. Avery - MDNR
J. Bails - MDNR
R. Babcock - MDNR

xc: T. Julian
R. Babcock

RECEIVED
OCT 24 1984
SWQD COMPLIANCE 2

Deroras
Koorstra

STATE OF MICHIGAN

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

RONALD O. SKOOG, Director

September 25, 1984

TO: Stewart H. Freeman, Assistant Attorney General in Charge
Environmental Protection Division
Department of Attorney General

FROM: Jack D. Bails, Chief, Environmental Enforcement Division

SUBJECT: SWS Silicones Corporation, Adrian
Groundwater Contamination

SWS Silicones Corporation is a subsidiary of Stauffer Chemical Company. The Adrian plant manufactures a variety of silicone products including rubbers, sealants, antifoams, fluids, and emulsions. Many different chemicals and manufacturing processes are involved. Treated wastewater is discharged to the River Raisin under the terms of NPDES permit No. MI 0026034.

A 1979 point source study noted the existence of an unlined "black pond" (evaporation/settling lagoon) which was used by the Company for disposal of bad batches, floor washings, and reactor vessel washings, about 30,000 gallons per month. Methyl chloroform (1,1,1-trichloroethane; TCA) was detected in the pond and in the discharge from the outfall. The permit did not, at that time, authorize the discharge of TCA. Also in 1979, staff learned of an old "disposal area" on the plant site, where the Company had buried 100-200 barrels.

A Notice of Violation was issued in February, 1980 for the unauthorized surface water and groundwater discharges of TCA. After a number of meetings and exchanges of correspondence, the Company agreed to perform a Phase I hydrogeologic study in the area of the black pond and to close the pond. The Phase I study was submitted in September, 1980; the results indicated the existence of a contaminated "perched" aquifer downgradient of the pond, with some leakage into the lower water table aquifer. Both aquifers flow toward the River. Staff concluded that additional hydrogeologic study was necessary, both in the pond area and in the barrel disposal area. Staff also concluded that the Company's closure plan for the pond was inadequate.

Correspondence between the Company and staff on these issues continued throughout 1981. The NPDES permit was reissued on December 21, 1981, with requirements for closure of the pond, additional hydrogeologic studies, and a process characterization study. The permit required the Company to clean-up the groundwater if the Water Resources Commission determined that the contamination presented an "unacceptable risk" to public health, safety or welfare, or to the uses of the surface or groundwaters. The permit also authorized the discharge of TCA to the River Raisin. The permit expired December 31, 1982.

The Phase II study plan was approved in April, 1982, and the pond closure plan was approved in July, 1982. The liquid from the pond was removed to the Company's treatment system, the remaining sludges were stabilized, and the pond was capped in 1982; DNR approved the closure in November, 1982. Preliminary data on the barrel disposal area groundwater were submitted in September, 1982, with a final submittal made on February 24, 1983. Groundwater monitoring results from the pond area were submitted on December 23, 1982.

Staff responded to the Company's February 1983 submittal on August 2, 1983, stating that staff would recommend that the WRC find that an "unacceptable risk" was presented by the contamination in the barrel disposal area. The aquifer downgradient of the disposal area flows toward the river and is contaminated with TCA, trichloroethylene (TCE), tetrachloroethylene, and other organics. Four of the compounds were found at levels which would exceed water quality-based effluent limits for a surface water discharge. Additional hydrogeologic study would be necessary to fully define the vertical and horizontal extent of the plume. The plume is apparently contained on company property and no private wells are threatened.

Correspondence and meetings with the Company continued during the remainder of 1983 and through the spring of 1984 on the subject of the barrel disposal area. A proposed Final Order was prepared by staff to require removal of the barrels and restoration of the groundwater. The Company has agreed to remove the barrels and "grossly contaminated" soils, but has refused to undertake a purge and treatment system. The barrel removal program is now underway. The contamination downgradient of the black pond was never addressed by either the company or staff.

A copy of the relevant file materials is attached. I am requesting that you assign an attorney to assist us in reaching an appropriate resolution of this matter. The Company's attorney, David Tripp, has requested that we meet again to attempt to reach an agreement. Valerie Harris and Don Inman are assigned to the case from this division. Thank you for your assistance.

Karl D. Harris

JDB:VSH:sm
attachment
cc: Zugger
Johns
cc: B. Bobcock
D. Cummins

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

August 10, 1984

TO: Steve Eldredge, Surface Water Quality Division, Jackson
Ron Kooistra, Groundwater Quality Division, Jackson
Dan Cummins, Groundwater Quality Division, Jackson

FROM: Valerie Harris, Environmental Enforcement Division vsh

SUBJECT: SWS Silicones Corporation

The Company submitted Phase II hydrogeological information and analytical results of the groundwater contamination downgradient of the "black pond" in December 1982, as required by the NPDES permit. This information was apparently never reviewed by the Department, and I was unable to locate a copy in the "main" file. The Company has forwarded a new copy at my request, which is attached for your review and comments.

As part of your review, you should be aware that a First Phase Hydrogeologic study of this area was submitted in 1980, together with limited analytical data. There is considerable correspondence on this subject in the file. If this information is not available in the district files, please contact me to arrange a review of the main files which are in my office. I also have Bill Iversen's old file.

I would appreciate an early review of this information so that we may include the Department's evaluation and recommendations in our referral to the Attorney General's Office. Please call me if you have any questions.

VSH:cf
Attach.
cc: Inman
Baldwin

RECEIVED
AUG 16 1984

RECEIVED
MAR 2 1984
Region III Headquarters

SWS SILICONES - DRUM BURIAL

Permit Issued 12-21-81 to expire 12-31-8[illegible]

Part II.A. : Special condition - Hydrogeological investigation

Determine extent of contamination from buried barrels, sludge disposal area and other possible sources

Determine horizontal + vertical extent of contamination in perched aquifer

Determine extent of contamination in lower aquifer

Determine impact on river

If Chief WQD finds unacceptable risk, permittee will be notified. Then institute groundwater restoration program.

Part I C 3. Schedule of compliance

By 1-31-82 Submit Phase II hydrogeological study plan + obtain approval

By 6-30-82 Complete Phase II study + submit

If WQC finds unacceptable risk, WQC will transmit [illegible] be [illegible] restoration -

Then, submit within 120 days restoration plan [illegible]

Plan - restoration, treatment, ultimate disposal

Within 180 days of plan approval, begin restoration

Submit quarterly reports on restoration

[illegible] objectives [illegible]

SWS Silicones Corporation

ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

August 7, 1984

8-23-84 ~~Advised~~ Advised B. Babcock that I no additional comments. Bob indicated that he also had known of that he would the other persons who rec'd copies of this ~~letter~~, alK

Mr. Steve Eldredge
State of Michigan
Department of Natural Resources
Jackson District Supervisor
Surface Water Quality Division
4th Floor, State Office Building
301 E. Louis B. Glick Highway
Jackson, Michigan 49201

Re: Buried Barrels Proposal

Dear Mr. Eldredge:

This is in response to your letter dated July 26, 1984, concerning our proposal for buried barrel removal and disposal.

1. Hazardous waste determinations and characterizations will be made by SWS for all uncovered drum contents, for contaminated soils, and for "products" of treatment.

2. O.H. Materials Co. has been apprized of the possible condition of these drums. They will not operate heavy bulldozers on top of the drum site. They plan to very carefully remove some of the top cover, and to approach the drum ditch from the southeast end in a sideways removal style.

3. O.H. Materials Co. is taking standard precautionary measures in handling materials of unknown composition, and compatibility checks will be made on samples prior to combination for treatment, should treatment be required.

4. Section 3.5.1 is generalized because of the many unknowns involved. If possible, we plan to ship the neutralized liquid sludge, crushed drums, and the contaminated soils to Chem-Met Services for lime solidification and then disposal in a secured landfill. This general idea has been approved by Chem-Met Services. Final review by both Chem-Met Services and by SWS will be based upon waste analyses and characterizations.

5. We will analyze the soil core samples from the surface down, until we get a negative result, as per your suggestion.

RECEIVED
AUG 10 1984
JACKSON DISTRICT

xc: R. Kooistra
R. Basch
J. Larson
V. Harris

The tentative removal, treating, and disposal schedule is as follows:

1. Finalize contract with O.H. Materials, and get corporate capital spending approval by the end of August, 1984.

2. O.H. Materials on site for 3 weeks starting in early September, 1984.

3. Materials sent to treatment and/or disposal during September and October, 1984.

We note the strongly-held position of the Water Quality Division in the matter of groundwater restoration. While we do not recognize a need for the expenditure of resources on a transitory matter of little environmental consequences, we will evaluate approaches to groundwater restoration. It may be possible to utilize existing NPDES facility treatment capacity to handle groundwater at the rate specified in the draft NPDES permit you proposed in our June 7, 1984 meeting, i.e., approximately 20,000 gpd. We will be prepared to discuss this further when the barrel removal project has commenced.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 84-148, certified

cc: J. Calamungi
G. L. Ford
G. F. Lengnick
B. S. McClellan
T. J. Sayers

STATE OF MICHIGAN

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

RONALD O. SKOOG, Director

Reply to:

4th Flr. State Ofc. Bldg.
301 E. Louis Glick Hwy.
Jackson, MI 49201

RECEIVED
JUL 31 19..
Region III Headquarters

July 26, 1984

SWS Silicones Corporation
Adrian, MI 49221

Lenawee Co.

Attention: Mr. Gordon Philbrook

Ladies and Gentlemen:

Subject: Buried Barrels Proposal

This is in response to your June 20, 1984 submittal from the O. H. Materials Company entitled "Proposal for Removal and Disposal of Chlorosilane Drums".

The following comments are offered despite the fact that the company has not agreed to initiate and complete a groundwater restoration program as required by NPDES Permit MI0026034 and as contained in the draft Final Order of Abatement which was proposed at our meeting on June 7, 1984. The Department maintains its position that the groundwater restoration program is required, and the Department will continue to pursue that objective. However, in the interest of achieving a long sought goal of acceptable buried barrel removal and disposal, staff comments are as follows:

1. Hazardous waste determinations and basis for each determination should be made by the company for the drums and their contents (prior to and after treatment) and the removal of heavily and slightly contaminated soils. For example, slightly contaminated soils should be tested for ignitability, corrosivity and reactivity pursuant to 40 CFR, Part 261 of RCRA.

2. The proposal describes the use of heavy equipment which may further reduce the integrity of the barrels, e.g. bulldozer on top of the barrels and use of a Caterpillar 215 with a drum grappler attachment.

   Barrel integrity is important and all equipment should operate to maintain such.

3. What is the purpose of sample mixing ". . . to ensure compatibility . . ." in Section 3.3?

Gordon Philbrook
SWS Silicones
July 26, 1984
Page 2

4. Which method of liquid disposal is proposed and have the necessary approvals been gained?

5. In reference to Section 3.7, analysis of soil samples could proceed from the surface down. Deeper samples would be analyzed only where the previous sample showed a positive result.

It is requested that the company provide a response as to the company's intent to incorporate the above comments, and provide a schedule for actual barrel removal.

If you have any questions or comments, please do not hesitate to contact me or other appropriate staff.

Sincerely,

Steve Eldredge /RFB

Steve Eldredge, P.E.
Jackson District Supervisor
Surface Water Quality Division
517-788-9598

SE:sl

cc: R. Kobistra, GWQD
D. Cummins, GWQD
J. Larsen, AQD
R. Basch, HWD
V. Harris, EED

TABLE I

SWS SILICONES CORPORATION

M-1, M-2, M-3 Well Data, mg/l

	Well M-2			
	1/5/83	9/13/83	12/20/83	3/15/84
1,1 dichloroethane	N.D.	N.D.	N.D.	N.D.
t-1,2 dichloroethylene	N.D.	N.D.	N.D.	N.D.
1,1,1 trichloroethane	N.D.	N.D.	N.D.	N.D.
trichloroethylene	N.D.	N.D.	N.D.	N.D.
tetrachloroethylene	N.D.	N.D.	N.D.	N.D.
trimethyl silanol	0.05	N.D.	N.D.	N.D.

1/5/83	[illegible]	[illegible]/83	3/15/84
N.D.	[illegible]	[illegible]	N.D.
0.02	[illegible]	[illegible]	N.D.
N.D.	[illegible]	[illegible]	N.D.
N.D.	[illegible]	[illegible]	N.D.
N.D.	[illegible]	[illegible]	N.D.
N.D.	[illegible]	[illegible]	N.D.

Note: 1. All data on M-1 well (west of the old buried drum area) taken in January, September, and December, 1983, as well as March, 1984 showed "N.D.".

2. M-2 is located south of buried drum area.

3. M-3 is located east of drum area.

4. These three wells are screened 35 to 40 feet deep.

5. N.D. (Not Detected) limit is about 0.01 mg/l on organics and 0.1 mg/l on trimethyl silanol.

TABLE II

SWS SILICONES CORPORATION

M-4s and M-4d Well Data, mg/l

	Well M-4s									Well M-4d	
	11/16/82	12/9/82	1/5/83	9/13/83	9/27/83(3)	10/12/83	11/16/83	12/20/83	[illegible]	[illegible]/21/83	3/15/84
1, 1 dichloroethane	0.30	0.20	0.16	0.06	0.27	0.04	0.07	0.06	[illegible]	N.D.	N.D.
t-1,2 dichloroethylene	1.20	0.80	1.02	0.22	0.82	0.08	0.20	0.18	[illegible]	N.D.	N.D.
1,1,1 trichloroethane	1.20	1.20	1.95	1.40	1.77	1.68	1.80	1.40	[illegible]	N.D.	N.D.
trichloroethylene	0.50	0.60	0.74	0.62	0.98	0.40	0.55	0.22	[illegible]	N.D.	N.D.
tetrachloroethylene	0.30	0.20	0.18	0.51	0.45	0.35	0.58	0.28	[illegible]	N.D.	N.D.
trimethyl silanol	~20	~25	~15	~ 2		~1	~1	~0.5	< [illegible]	N.D.	N.D.

Note: 1. M-4s well is southeast of the old buried drum area, in the direction of the groundwater flow, and is screened 35 to 40 feet deep.

2. M-4d well is 10 ft. downgradient from M-4s and is screened 66 to 71 feet deep.

3. Analyses by Shrader Laboratories.

4. N.D. (Not Detectable) limit is about 0.01 mg/l on organics and 0.1 mg/l on trimethyl silanol.

Kooistra
Jackson

July 19, 1984

RECEIVED
JUL 27 1984

TO: Jack Bails, Chief
Environmental Enforcement Division

FROM: Paul Zugger, Chief
Surface Water Quality Division

SUBJECT: (SWS Silicones Corporation Buried Barrels) Lenawee Co

SWS File
Groundwater Clean up

In the early 1970's, the SWS Silicones Corporation buried approximately 100 barrels of wastes in a small area on the company's 200 acre, rural, Adrian, Michigan plant site. The soils and groundwaters underlying the buried barrels are now contaminated with five chlorinated organic compounds, two of which are carcinogens. An average of the total chlorinated organics found in the groundwater over a 17 month period (nine samples) is 3.25 mg/l.

Although groundwater restoration requirements are contained in NPDES Permit MI0026034 (Part I A. 6. and Part I C. 3.), they do not become effective until the Water Resources Commission determines that an unacceptable risk exists and advises the company of same. This matter has not been taken to the Water Resources Commission. However, staff letters have advised the company of our intent to recommend that the Water Resources Commission make such a risk determination.

Following numerous meetings and letters over a 12 month period, the company only recently expressed a willingness to remove the barrels and heavily contaminated soils. However, the company does not agree to purge and treat the groundwater due to their company's cost-benefit analysis.

No residential wells have been impacted by the contaminants nor is it likely to occur. The company's hydrogeological report indicates that the contaminated aquifer discharges to the River Raisin and staff concurs.

The unauthorized discharge from the buried barrels of wastes to the groundwaters is in violation of Section 6(a) and 7(1) of Act 245, P.A. 1929, as amended. This violation is hereby referred to your division for appropriate enforcement action. Subsequent Surface Water Quality Division actions will be coordinated with your office. Frank Baldwin, Compliance 2 Section Chief is hereby assigned as the liaison for this Division in this matter.

Attached is a three-ring binder of pertinent file material in this matter. Other materials are available upon request.

Also attached is a draft response letter to the company's drum and soil removal proposal. I am asking your early review of this proposed response letter so that drum and soil removal can take place.

Finally, for your information, due to a labor complaint in 1983, staff of the Toxic Substance Control Commission have, in the past, expressed an interest in this matter.

Attach.

cc: S. Eldredge
R. Kooistra
W. McCracken/C. Bek
J. Grant

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

RECEIVED
JUL 6 1984
SAGINAW DISTRICT
H. W. SWQD GWQD LAW, AIR

INTEROFFICE COMMUNICATION

July 3, 1984

TO: Ron Kooistra, Supervisor, Jackson District, Groundwater Quality Division

FROM: Daniel O. Cummins, Geologist, Lansing District, Groundwater Quality Division

SUBJECT: Clean-Up Proposal SWS SIlicones, Lenawee County

DOC

I have reviewed the O.H. Materials Company clean-up proposal and have the following comments:

1. I question the use of a "bulldozer" to remove sediment from on top of the drums. Groundwater contamination indicated that the drums are not secure. A bulldozer may not be supported by the drums. An alternative should be proposed by the company.

2. The specially equipped Caterpillar 215 may be suitable for intact, sturdy drums. However, I again state that the drums may not have maintained their integrity. An alternative should be available.

3. I do not understand the reference to "mixing" in Section 3.3 of the proposal.

4. Many methods for liquid disposal are proposed. Which will be employed?

5. The "hazardous waste" determination should be made by the company. Concurrance in writting should be made by Hazardous Waste Division. I would think this determination could be made now.

6. Sediment sampling at 2 foot intervals at four locations in the bottom of the excavation is acceptable. Analysis of samples could proceed from the surface down. Deeper samples would be analysed only when the previous sample showed a positive result. For example, analyse consecutively the samples at 2, 4, and 6 feet, stopping at 6 feet if samplings were negative. Clean up level would then be 6 feet.

Generally, I think the proposal was lacking on several issues. The treatment facility to be constructed would appear to be a good way to handle reactive wastes. However, clean up of the treatment plant must by considered. In addition, I would like to emphasize that even though the MDNR has commented on the proposal and agrees that the material should be removed, the MDNR cannot sanction the activities by formally accepting the proposal.

The Department's response to the company should include a special paragraph re-emphasizing MDNR desire to bring about an acceptable clean-up with the company's cooperation.

DOC/sb

cc: Bob Babcock

RECEIVED
JUL 10 1984
JACKSON DISTRICT
SWQD GWQD

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 · TELEPHONE (517) 263-5711

June 20, 1984

Mr. Steve Eldredge
Michigan Department of Natural Resources
Surface Water Quality Division
Jackson District Office
4th Floor, State Office Bldg.
301 E. Louis B. Glick Hwy.
Jackson, MI 49201

Re: Buried Barrels

Dear Mr. Eldredge:

Pursuant to the meeting in Lansing on June 7, 1984 regarding the aforementioned subject, enclosed are five copies prepared by O.H. Materials Co., entitled "Proposal for Removal and Disposal of Chlorosilane Drums".

As we mutually agreed at the meeting, it will be advantageous to all concerned if we can commence this activity as soon as possible.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 84-128
certified mail
5 attachments

cc: J. Calamungi
G. F. Lengnick
T. J. Sayers
G. L. Ford
B. S. McClellan

RECEIVED
JUN 27 1984
GQD-COMPLIANCE

RECEIVED
JUN 22 1984
JACKSON DISTRICT

XC: R. Kooistra, GWQD
J. Larsen, AQD
R. Basch, HWD
D. Cummins, GWQD

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

May 31, 1984

TO: Ron Koolstra, Groundwater Quality Division, Jackson
Dan Cummins, Groundwater Quality Division, Lansing
Paul Zugger, Surface Water Quality Division, Lansing
Frank Baldwin, Surface Water Quality Division, Lansing
Val Harris, Environmental Enforcement Division, Lansing

FROM: Steve Eldredge, Jackson District Supervisor, SWQD

SUBJECT: Meeting on SWS Silicones - Buried Barrels

The meeting originally scheduled for June 1 has been changed to June 7. The 1:30 meeting with company representatives will be preceeded by a staff meeting at 11:00. We will discuss the proposed Final Order at the 11:00 meeting. Both meetings will be held in the Ottawa Building in the Hazardous Waste Division's conference room.

SE:lc

cc: R. Babcock

Steve Eldredge

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

May 22, 1984

TO: Ron Kooistra, Dan Cummins (GWQD)
Paul Zugger, Frank Baldwin (SWQD)

FROM: Steve Eldredge

SUBJECT: Meeting on SWS Silicones

This memo confirms the June 1, 1984 meeting with SWS Silicones at 1:30 in the 4th floor conference room, Mason Building. The meeting was requested by the company to discuss cleanup activities related to buried barrels. The discussion is expected to deal mainly with the need to intercept and treat contaminated groundwater.

Mr. Tom Sayers, Mr. Gary Ford and Mr. Gordon Philbrook will represent the company. They will have had a chance to review our draft Final Order prior to the meeting.

Steve Eldredge

SE:sl

cc: B. Babcock

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

May 8, 1984

TO: Steve Eldredge, Compliance #2
Surface Water Quality Division

FROM: Linn Duling, Toxic Chemical Evaluation Section LD
Environmental Services Division

SUBJECT: SWS Silicones "Old Drum Burial Site"

Per Paul Zugger's request (April 27, 1984), we have determined the following 10^{-6} cancer risk and human life cycle safe concentration (HLSC) groundwater criteria values for the organic chemicals present in the groundwater as a result of the "old drum burial site" at the subject facility.

Chemical	10^{-6} Cancer Risk Value	HLSC
Trichloroethylene[1]	2.8 ug/l	--
Tetrachloroethylene[1]	0.63 ug/l	--
1,1,1 - Trichloroethane[2]	--	18,750 ug/l
1,1 - Dichloroethane[2]	--	I.D.[3]
1,2 (trans) Dichloroethylene[2]	--	I.D.
Trimethyl silanol[2]	--	I.D.

1 - carcinogen
2 - non-carcinogen
3 - Insufficient data

Due to insufficient data, HLSC values could not be calculated for 1, 1-dichloroethane, 1, 2 (trans) dichloroethylene and trimethyl silanol. The minimum data required to derive a HLSC is an acute oral LD_{50} for rats.

If you have any questions, please contact me.

cc: Grant/file
Anticoli

xc: R. Kooistra

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

May 2, 1984

TO: Chang Bek, Chief
Industrial Unit, Permits Sect.

FROM: Robert F. Babcock RFB
Jackson District

SUBJECT: SWS Silicones Corporation Buried Barrels
Groundwater Restoration Discharge

As discussed in our staff meeting on April 27, 1984, the following flow and concentration information is submitted to initiate the drafting of surface water discharge authorizations, NPDES permit and Final Order, for the subject discharge. The Jackson Surface Water Quality District staff provide the following estimates for surface water discharge authorization development:

Flow: 19,320 gpd

Basis: The company's hudrogeologist memo dated February 14, 1983 uses a flow of 9,659.6 gpd to compute a groundwater containment mass loading. Staff added a factor of two to recognize the draw-down required to control the plume.

Parameters: (all mg/l)

1, 1 - dichloroethane	0.14
t - 1, 2 dichloroethylene	0.54
1, 1, 1 - trichloroethane	1.59
trichloroethylene	0.59
tetra chloroethylene	0.39
trimethyl silanol	8.19

Basis: The above parameters have been identified by company sample analysis. The concentrations are averages of nine (9) samples of groundwater monitoring well M-4s taken from November 15, 1982 through March 15, 1984.

It should be noted that GWQD staff did not provide the above information inasmuch as they felt this information should be supplied by the company in a groundwater restoration proposal. That is, they felt that staff should not design the restoration, but review it once submitted.

RFB:sdl

cc: S. Eldredge
R. Kooistra
F. Baldwin

STATE OF MICHIGAN

APR 26 1984

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

RONALD O. SKOOG, Director

Reply To:
Region III Headquarters
4th Floor
Jackson State Office Bldg.
301 E. Louis Glick Hwy.
Jackson, MI 49201

April 23, 1984

SWS Silicones Corporation
3901 Sutton Road
Adrian, MI 49221

Attention: Mr. Gordon Philbrook

Ladies and Gentlemen:

Re: Buried Barrels of Waste

The purpose of this letter is to:

1. Direct SWS Silicones, Corp. to submit a barrel and sediment removal plan to this office by not later than May 15, 1984.

2. Confirm the April 12, 1984 meeting and comment on the company's January 27, 1984 submittal.

Barrel Removal Plan

The company has received at least one proposal from a waste cleanup contractor for the removal and disposal of the buried barrels of waste and adjacent contaminated soils. The company is directed to submit the company's selected proposal for the Department's review by not later than May 15, 1984. To facilitate an expeditious review by staff, it is suggested that at least four copies be submitted. The proposal shall address proper handling and safety procedures and shall include a time schedule for commencing and completing the removal/disposal activity.

April 12, 1984 meeting and comments on the company's January 27, 1984 submittal

A. At our April 12, 1984 meeting, several points related to the hydrogeology and cleanup of the site were agreed to by both company and the Department of Natural Resources representatives. These points are as follows:

   1. The aquifer of concern discharges to the River Raisin.

   2. Current data indicates that only the upper, currently contaminated aquifer is involved and that it appears unlikely that a deeper aquifer will become involved.

   3. The vertical and horizontal extents of the contamination plume have apparently been identified.

4. The DNR acknowledged also, that the current extent of the hydrogeologic investigation is adequate for the remedial activities currently under consideration.

5. Department review of the company's submittals dated February 24, 1983 and January 27, 1984 confirms the above findings. These submittals were required for compliance with NPDES Permit No. MI0026034, issued December 21, 1981 Part IA6. Special Condition - Hydrogeological Investigation, and Part IC Schedule of Compliance 3b. These submittals comply with these permit requirements.

B. Also at our meeting we discussed, in hypothetical terms, basic DNR requirements regarding this situation. These requirements include removal of the barrels, removal of as much contaminated sediment as possible and restoration of the groundwater to its natural background quality (i.e. non-detectable levels in samples). The means by which these tasks would be accomplished was open to discussion and negotiation.

C. It was agreed that clay capping is probably not needed following removal of the barrels.

D. The company handed out at the meeting, additional groundwater monitoring well data which contained results for samples taken on March 15, 1984 (refer to Tables I & II of January 27, 1984 submittal). Excluding the trimethyl silanol data, well M-4s consistently shows approximately 3.5 mg/l total chlorinated organics to be present in the contaminated groundwater with little change apparent in 9 samples over a 16 month period of time.

E. Contaminated groundwater (naturally) discharging to the River Raisin is an unauthorized discharge. Mr. Duling's July 14, 1983 memorandum to Steve Eldredge identified surface water levels of concern for five chlorinated organic compounds based on cancer risk or chronic aquatic toxicity, or both. The concentrations of four of the five compounds in the contaminated groundwater are higher than the indicated levels of concern. Discussions within the agency of the concepts of affording dilution (i.e. an authorized discharge's mixing zone) or requiring the more restrictive interception and treatment to meet treatment technology limitations for these chlorinated compounds are not completed. The company will be advised of the agency's position in the near future.

F. A draft Remedial Action Agreement is being prepared for your consideration and will be sent to you soon.

G. Pursuant to your request, we have enclosed copies of analytical protocols for Purgeable Halocarbons (Scan 1) and Aromatic Hydrocarbons (Scan 2). Also enclosed is the guide for collecting sediment samples for the purgeable organics.

Any additional discussions necessary to effect a Remedial Action Agreement is encouraged as soon as possible so that the cleanup can be completed. If you have questions or comments, please do not hesitate to contact either of us.

Sincerely,

Steve Eldredge

Steve Eldredge, P.E.
Surface Water Quality Division

Ronald D. Kooistra

Ronald D. Kooistra, P.E.
Groundwater Quality Division
(517) 788-9598

Encl.

SE:RK:sl

cc: F. Baldwin
D. Dennis
J. Larsen
R. Basch
D. Cummins
Lenawee County Health Dept.

STATE OF MICHIGAN

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

RONALD O. SKOOG, Director

Reply To:

4th Floor
State Office Building
301 E. Louis Glick Hwy.
Jackson, MI 49201

February 13, 1984

SWS Silicones Corporation
Adrian
Michigan 49221

Attention: Mr. Gordon Philbrook

Ladies and Gentlemen:

Re: Buried Barrels

This is to acknowledge receipt of your January 27, 1984 submittal regarding the buried barrels and to advise that staff hopes to complete the reviews of this submittal by March 15, 1984.

The former Groundwater District Supervisor, Mr. Elmore Eltzroth, has accepted a different position and other Groundwater Quality Division staff will undoubtedly be involved in the review of this submittal. These staff will need time to become familiar with this matter.

If you have any questions or comments, please do not hesitate to contact me at (517) 788-9598.

Sincerely,

Steve Eldredge

Steve Eldredge
Jackson District Supervisor
Surface Water Quality Division
(517) 788-9598

SE:lc

cc: R. Babcock
J. Grant, T.C.E.S.
R. Mosier, GWQD-Lansing

R1026-1

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

January 27, 1984

State of Michigan DNR
Surface Water Quality Division
4th Floor
Jackson State Office Bldg.
301 E. Louis B. Glick Hwy.
Jackson, MI 49201

Attn: Mr. Steve Eldredge
Jackson District Supervisor

Re: SWS Silicones Corporation
Buried Barrels

Dear Sirs:

Attached you will find a data package comprising information which SWS agreed to provide in our letter of December 15, 1983. In large measure, this information is being provided in response to the issues raised in your November 29, 1983 request for information regarding the buried barrels. We caution that much of the descriptive information regarding the barrels and their contents does not represent precise knowledge, but is the result of inquiry and records investigation for the period when the burial occurred. We have attempted to provide the most accurate description of the buried materials, their quantity and an estimate of present condition which the information available to us would permit.

In addition to the monitoring well data requested in your letter, we are enclosing a report by Gilbert Commonwealth Associates, Inc. which further evaluates the groundwater hydrogeology and concludes that any groundwater subject to contamination from this small drum burial discharges to the Raisin River.

SWS has proposed clay capping of the drum field and re-terraining to avoid percolation of rainwater in the burial area. Furthermore, we have indicated our concern for safety and environmental problems which may be associated with an attempt to remove these drums. We do not argue that removal is technically infeasible, merely ill-advised. There appears to be no just cause to incur the risks that may be associated with the project. We have several times requested an objective risk assessment which would justify the Department's claim that "an unacceptable risk to public health, safety and welfare" does in fact exist. We feel that we have demonstrated through hydrogeological as well as analytical data that the discharge is to the Raisin River and that both the rate and total quantity of discharge are of no significance and in fact cannot be detected in the river water. Nevertheless, in response to your request for a plan for removal, we have contacted two contractors specializing in waste removal. While both expressed interest in the project, we have been unable to obtain proposals and cost estimates from either company to date, in spite of consistent follow-up. We do anticipate a response from at least one in the very near future. We cannot, therefore, at this time comply with your request for a plan and schedule for drum removal, even if we were willing to accept the contention that such removal is necessary.

SWS believes that the above-referenced report by Gilbert Commonwealth Associates, Inc. and the well monitoring data, including data from a new deeper well, are responsive to your request for additional information regarding the need for groundwater restoration. SWS feels that the data amply justifies reconsideration of your groundwater restoration objectives and that completion of a remedial action program for the buried drum area will result in full groundwater restoration.

SWS feels that there would be merit to a further face-to-face discussion on these issues and we suggest that a meeting between appropriate DNR and SWS staff personnel be arranged as soon as possible.

Sincerely,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 84-28, certified, attachs.

cc: L. B. Bruner*
J. Calamungi*

*no attachments

SWS SILICONES CORPORATION

Buried Drums Information

Introduction- There are no records of the drum burial, except for one drawing, number 0-085, dated September 27, 1972, which is labeled "Buried 100 drums mixed silanes". This drawing is enclosed with this package. Some of the silanes may have come from Wacker-Chemie as a raw material; some may have come from our own operations.

Item 1. A plan for removal and disposal of the barrels.

We have contacted two contractors for a rough estimate of how to safely remove and dispose of the drums, and at what cost.

Item 2. The process which generated the wastes:

Chlorosilanes are produced in a direct-fluid bed-reactor by the reaction of silicon metal with gaseous methyl chloride, with the aid of zinc and copper oxide catalysts:

$$Si + 2\ CH_3Cl \longrightarrow Cl\text{-}\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{Si}}}}\text{-}Cl$$

dimethyldichlorosilane

Other "side product" silanes are also produced, such as:

$$Cl\text{-}\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{Si}}}}\text{-}CH_3$$ trimethylchlorosilane

```
      Cl
      |
  Cl-Si-CH3        methyltrichlorosilane
      |
      Cl


      Cl
      |
   H-Si-CH3        methyldichlorosilane
      |
      Cl
```

These chlorosilanes are then purified and separated in distillation columns. Other types of silanes can be produced by introducing ethyl and/or propyl groups, and other organic groups. Various chlorinated solvents may be used to clean out the vessels, heat exchangers, columns, pumps, and lines. These could include trichloroethylene, tetrachloroethylene, and 1,1,1 trichloroethane.

Item 3. A description of the wastes including chemical name, concentration and total volume.

The waste description and concentration is unknown, since no records were kept of this one-time-only drum burial. The waste drums are believed to have contained the various chlorosilanes listed above, some with minor but unknown quantities of various clean-out solvents. As noted in item 8, these compounds do not survive contact with water. An MSDS sheet for hydrochloric acid is attached. Some MSDS sheets for chlorosilanes are also attached. along with some other published data.

The total volume is described in item 5.

Item 4. The reason for utilizing this method of "disposal".

It was a management decision at that time to bury these drums. No safe, alternative method could be identified, and on-site burial posed very minimal risks. These materials are corrosive liquids and are reactive with water or moist air.

Item 5. The number of barrels buried.

The only record is a drawing 0-085 which states "100 drums". Only a single burial is known to have occurred; hence, the stated figure is considered to be a close estimate.

Item 6. A description of the burial practice.

The drawing mentioned above states six foot deep. Recollections of employees was that the drums were lined up vertically, so the cover is probably three feet.

Item 7. A description of the burial location.

Drawing 0-085 is attached.

Item 8. The projected chemical composition of the wastes currently.

Chlorosilanes will react with water to form a silicone gel and muriatic acid:

$$X \quad Cl-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{Si}}}}-Cl + HOH \longrightarrow HO-\left(\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{Si}}}}-O\right)_x-H \;+\; HCl_{(solution)}$$

When this occurs in the open, a gaseous cloud of HCl is very likely. The resultant silicone gel is non-toxic and non-hazardous.

Item 9. Environmental concerns associated with barrel removal.

As shown by the MSDS sheets, chlorosilanes are acidic (corrosive), reactive, and flammable liquids. When water is present (even air moisture) a reaction quickly occurs and gaseous HCl is released. In addition, certain classes of silanes may also, upon reaction with water, release hydrogen, thus creating a potential explosion hazard.

Item 10. Recent monitoring well data.

Refer to attached-tables I and II. Enclosed is a report of additional hydrogeological work conducted by Gilbert/Commonwealth Associates, Inc. which concludes that the groundwater in the upper 40 ft. of the sand aquifer is moving laterally beneath the drum disposal area and is discharging to the River Raisin.

Also enclosed is a copy of the drawing, "Well Log-Sutton", dated 1/6/64, numbered "MISC-2", which presents the logs for deep exploratory wells. The significance of these logs is that they record the occurrence of an areally extensive "Blue Clay" beneath the drum disposal area at an elevation of about 680 feet, which is consistant with the finding of the enclosed Gilbert/ Commonwealth report.

TABLE I

SWS SILICONES CORPORATION

M-1, M-2, M-3 Well Data, mg/l

	Well M-2			Well M-3		
	1/5/83	9/13/83	12/20/83	1/5/83	9/13/83	12/21/83
1,1 dichloroethane	N.D.	N.D.	N.D.	N.D.	0.005	N.D.
t-1,2 dichloroethylene	N.D.	N.D.	N.D.	0.02	0.015	N.D.
1,1,1 trichloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
trichloroethylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
tetrachloroethylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
trimethyl silanol	0.05	N.D.	N.D.	N.D.	N.D.	N.D.

Note: 1. All data on M-1 well (west of the old buried drum area) taken in January, September, and December, 1983, showed "N.D.".

2. M-2 is located south of buried drum area.

3. M-3 is located east of drum area.

4. These three wells are screened 35 to 40 feet deep.

5. N.D. (Not Detected) limit is about 0.01 mg/l on organics and 0.1 mg/l on trimethyl silanol.

TABLE II

SWS SILICONES CORPORATION

M-4 and M-4d Well Data, mg/l

	Well M-4								Well M-4
	11/16/82	12/9/82	1/5/83	9/13/83	9/27/83(3)	10/12/83	11/16/83	12/20/83	12/21/8
1,1 dichloroethane	0.30	0.20	0.16	0.06	0.27	0.04	0.07	0.06	N.D.
t-1,2 dichloroethylene	1.20	0.80	1.02	0.22	0.82	0.08	0.20	0.18	[illegible]
1,1,1 trichloroethane	1.20	1.20	1.95	1.40	1.77	1.68	1.80	1.40	N.D.
trichloroethylene	0.50	0.60	0.74	0.62	0.98	0.40	0.55	0.22	N.D.
tetrachloroethylene	0.30	0.20	0.18	0.51	0.45	0.35	0.58	0.28	N.D.
trimethyl silanol	~20	~25	~15	~2		~1	~1	~0.5	N.D.

Note: 1. M-4 well is southeast of the old buried drum area, in the direction of the groundwater flow, and is screened 35 to 40 feet deep.

2. M-4d well is 10 ft. downgradient from M-4 and is screened 66 to 71 feet deep.

3. Analyses by Shrader Laboratories.

4. N.D. (Not Detectable) limit is about 0.01 mg/l on organics and 0.1 mg/l on trimethyl silanol.

Extra Adrian [illegible] Spec't

ADDITIONAL
HYDROGEOLOGIC INVESTIGATIONS
OF DISPOSAL AREA

FOR

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Prepared by:
Commonwealth Associates Inc.
209 East Washington Avenue
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January 12, 1984

Approved by:
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Annette Brewster, CPGS
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AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS
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ADDITIONAL
HYDROGEOLOGIC INVESTIGATIONS
OF DISPOSAL AREA

INTRODUCTION

In November, 1983, Commonwealth Associates Inc. (Commonwealth) supervised the installation of three new observation wells on the property of SWS Silicones Corporation (SWS) near Adrian, Michigan. The new wells were installed to determine the magnitude and direction of any vertical hydraulic gradients in the vicinity of the old waste disposal area located approximately 1,000 ft southwest of the plant production facilities. Previous investigations by Commonwealth established the nature of shallow subsurface materials (to depths of 40 ft) and the horizontal hydraulic gradient in this area.

SOIL SEQUENCE

Two soil borings, M-4d and M-5d, were drilled using hollow stem augers at the locations shown on Figure 1. Boring M-4d was sampled to a depth of 99.0 ft, which corresponds to elevation 672.1 ft National Geodetic Vertical Datum (NGVD). Boring M-5d was sampled to a depth of 53.5 ft, or elevation 669.9 ft NGVD. Soil samples were taken at approximate 5-ft intervals using a split-spoon sampler (Standard Penetration Test) and were classified in accordance with the Unified Classification System (Figures 2 and 3). Logs of the borings are presented in Figures 4 and 5. Figure 6 is a geologic profile constructed using the log of boring M-4, drilled in 1982, as well as those of the two new borings.

As shown on the geologic profile, the soils above elevation 695 ft NGVD are predominantly sand with varying amounts of silt (SP·SM or SM). The lens of clayey silt, silty clay, and sandy silt centered about elevation 760 ft NGVD is known to be discontinuous; it was present in only two of the four original borings drilled in the disposal area. A thin layer of gray silt (ML) was encountered in boring M-4d at elevation 726.6 ft, NGVD. Although similar material was also found in boring M-5d at elevation 720.4 ft NGVD, the continuity of this material as a single layer is not proven. Between elevations 695 and 678 ft NGVD, the soils consist of sandy to clayey silt (ML). At boring M-4d, the silt layer is underlain by a hard silty clay (CL). Similar material was encountered in boring M-5d at elevation 678 ft NGVD, but a subsequent sample indicated a layered deposit of silty clay, clayey silt, and silty sand. The layers probably interfinger with the silty clay found in boring M-4d.

OBSERVATION WELLS

Two-inch diameter observation wells were installed in borings M-4d and M-5d upon completion of drilling. A third, shallow well, M-5s, was installed adjacent to boring M-5d in a separate borehole. Each well consists of a Johnson, continuous-slot, stainless steel wellpoint attached to galvanized pipe with threaded couplings. The slot size for the wellpoints was 0.006 inch. Wells M-4d and M-5d were installed by driving the wellpoint to the desired depth through clean filter sand placed prior to withdrawing the hollowstem augers. No filter sand was used in constructed well M-5s. The borehole for this well was drilled to the top of the zone to be screened using solidstem augers and the wellpoint driven to its final depth through undisturbed formation material.

Special precautions were taken to minimize contamination of lower aquifer in the drilling and construction of the deep observation well, M-4d. The borehole was first drilled to a depth of 54 ft using solidstem and hollowstem augers. The augers were then flushed with clean water and drilling proceeded with a 3-inch roller bit in an open hole filled with a bentonite-based drilling fluid. In this manner, mixing of water from the upper and lower portions of the sand aquifer was avoided.

Construction details for all M-series wells, including the three new observation wells, are given in Table 1 (Revised). (This table originally appeared in Commonwealth Report R-2451, Hydrogeologic Investigation of Disposal Area," dated August 1982.) Screened intervals are 2 ft in wells M-5s and M-5d, and 5 ft in M-4d. In addition to the 2-ft wellpoint, the screen in well M-4d includes a 3-ft length extension of Johnson, continuous slot, stainless steel screen, having a slot size of 0.012 inch. It should be noted that the elevation of filter sand in wells M-5s and 5d actually represents the top of formation sand following collapse of the borehole as the augers were withdrawn. Cement-bentonite grout was placed directly over the collapsed sand in these wells, and over the filter sand in well M-4d. In wells M-5s and M-5d, the grout seal extends to within 2 to 4 ft of the ground surface, while in well M-4d, the grout seal extends from the top of the sand filter to a depth of 31 ft below ground. The remainder of the annular space was backfilled with cuttings from the boreholes.

All three of the new observation wells were developed by direct pumping until the water was clear and free of sand. Because the water level in wells M-5s and M-5d was within 5 ft of the ground surface, a centrifugal pump was attached directly to the galvanized casing of these wells. Total development time was approximately 30 minutes and 90 minutes for wells M-5s and M-5d, respectively. The measured capacity of the wells at the completion of development was 10 gallons per minute (gpm) for well M-5s, and 2-1/4 gpm for well M-5d. Well M-4d was developed with a deep well jet pump because the static water level during drilling was about 34 ft below ground. Approximately 5 hours of well development time was required to produce a clear, sand-free condition in this well. The final capacity of well M-4d was 1-1/2 gpm.

WATER LEVELS

Ground water levels were measured in all observation wells on SWS property except M-4d on November 23, 1983. (Development of well M-4d was completed on November 24, 1983.) The water level in well M-4d on November 23 was extrapolated from measurements of water levels in wells M-4d and M-4s taken by SWS personnel on November 28 and 30, 1983. These water levels are plotted on Figure 1, which shows water table contours on November 23, 1983. To permit comparison with shallow well readings at the same location, ground water levels measured in deep wells are written in italics on Figure 1. The river level varied during the field work, but was measured at 711.83 ft NGVD on November 22, 1983, near its highest observed level.

Water levels measured in wells M-4s and M-4d are tabulated below:

	Nov. 23, 1983	Nov. 28, 1983	Nov. 30 1983
M-4s	738.31 ft	738.26 ft	737.78 ft
M-4d	(738.29) ft*	738.23 ft	737.77 ft

*Extrapolated from readings of November 28 and 30, 1983.

Based upon these values, there is essentially no downward vertical hydraulic gradient in the sand aquifer at the location of well M-4. (It should be noted that well M-4d is about 10 ft downgradient of well M-4s.) Given the similarity of the soils at the locations of wells M-1, M-2, M-3, and M-4, it may be concluded that ground water movement is predominantly lateral through the waste disposal area, with a negligible component of vertical flow. From Figure 1, the average horizontal hydraulic gradient in the waste disposal area was determined to be 0.020, or 20 ft in 1,000 ft, which closely correlates to the average hydraulic gradient of 0.019 determined for this area on June 17, 1982.

Water levels in wells M-5s and M-5d also demonstrate a lack of significant downward vertical hydraulic gradients near the upland edge of the floodplain. The difference in water levels measured three times over a one week period varied from 0.12 to 0.17 ft, with M-5s having the higher level. (It should be noted that M-5d is approximately 6 ft downgradient of well M-5s.) Static water levels observed during drilling corresponded to the ground surface in the adjacent swamp, which was no more than 10 to 15 ft away from the drilling sites. Direct observations indicated the swamp surface was very soft and saturated, even though it was at least 10 ft above the river level. At its closest approach, the river is less than 200 ft from wells M-5s and M-5d.

CONCLUSIONS

Based upon the results of the present and previous investigations, ground water in the upper 40 ft of the sand aquifer is moving laterally beneath the waste disposal area and is discharging to the River Raisin and/or the adjacent swamp. Evidence for this conclusion includes:

1. Lack of a downward vertical gradient in the waste disposal area;

2. The presence of a lower permeability silt layer beneath the sand aquifer at both the upland and floodplain locations;

3. Ground water levels measured in the floodplain wells (M-5s and M-5d) that are at least 10 ft above the river level; and

4. Ground water levels in the floodplain wells at or above the ground surface in the adjacent swamp.

TABLE 1 (Revised)

WELL INSTALLATION SUMMARY

Well No.	Date Installed	Location Plant Coordinates	Measuring Point Elev. ft, NGVD	Casing Height Above Ground ft	Ground Elev. ft, NGVD	Screened Interval Depth* /Elevation ft ft, NGVD	Elev., Top of Sand Filter ft, NGVD	Elev., Top of Bentonite Seal ft, NGVD
M-1	6/08/82	N 48,826 E 25,337	783.28	2.8	780.5	34.5-38.5/742.0-746.0	747.5	749.5
M-2	6/09/82	N 48,483 E 25,572	777.79	2.8	775.0	35.4-40.4/734.6-739.6	743.8	746.2
M-3	6/09/82	N 48,647 E 25,998	773.41	2.5	770.9	34.4-39.4/731.5-736.5	739.9	742.9
M-4	6/10/82	N 48,556 E 25,827	773.74	2.3	771.4	35.2-40.2/731.2-736.2	745.6	746.6
M-4d	11/23/83	N 48,550** E 25,830**	774.04	2.9	771.1	66.1-71.1/700.0-705.0	719.1	(none)
M-5	11/18/83	N 47,910** E 26,215**	725.67	2.1	723.6	13.1-15.1/708.5-710.5	719.5	(none)
M-5d	11/17/83	N 47,916** E 26,215**	726.45	3.0	723.4	29.4-31.4/692.1-694.1	708.4	(none)

*Below ground
**Approximate only

Note:

1. During development of well M-1, the bottom plug separated from the well screen, allowing formation sand to enter the well. After flushing with clear water, pea gravel was added to a height of 6 inches above the base of the screen. The well was then sealed with 6 inches of cement, which was allowed to cure for 3 days before the well was redeveloped. Total reduction in screen length by this procedure was 1 foot, leaving 4 feet open to the aquifer.

FIGURE 1
(in pocket)

GENERAL NOTES FOR LOG OF BORINGS

GRANULAR SOILS

COMPONENT	SIEVE SIZE RANGE
BOULDERS	8 in.
COBBLES	8 in. – 3 in.
GRAVEL (COARSE)	3 in. – 3/4 in.
GRAVEL (FINE)	3/4 in – #4 (4.75 mm)
SAND (COARSE)	#4 – #10 (2.00 mm)
SAND (MEDIUM)	#10 – #40 (0.425 mm)
SAND (FINE)	#40 – #200 (0.074 mm)
SILT	#200

RQD INTERPRETATION

RQD = TOTAL LENGTH OF RECOVERED CORE PIECES MEASURING 4". OR MORE IN LENGTH, EXPRESSED AS A PERCENTAGE OF THE TOTAL LENGTH OF THE CORE RUN.

DESCRIPTIVE TERM	RQD, PERCENTAGE
VERY POOR	0-25
POOR	26-50
FAIR	51-75
GOOD	76-90
EXCELLENT	91-100

DEGREE OF COMPACTNESS OF GRANULAR SOILS

N-BLOWS/FT	DESCRIPTION
<4	VERY LOOSE
4-9	LOOSE
10-29	MEDIUM DENSE
30-49	DENSE
50-80	VERY DENSE
>80	EXTREMELY DENSE

CONSISTENCY OF COHESIVE SOILS

N-BLOWS/FT	UNCONFINED COMPRESSIVE STRENGTH, qu, TSF	CONSISTENCY
<2	qu < 0.25	VERY SOFT
2-3	0.25 ≤ qu < 0.50	SOFT
4-7	0.50 ≤ qu < 1.00	MEDIUM STIFF
8-14	1.00 ≤ qu < 2.00	STIFF
15-30	2.00 ≤ qu < 4.00	VERY STIFF
>30	4.00 ≤ qu	HARD

N= NUMBER OF BLOWS OF A 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE A 2 IN. O.D. SPLIT-SPOON SAMPLER ONE FOOT.

LEGEND

- ⊠ – STANDARD PENETRATION TEST
- ■ – UNDISTURBED SOIL SAMPLE
- ◪ – DISTURBED SOIL SAMPLE
- □ – LOST SOIL SAMPLE
- CR – CORE RUN NO.
- 22 – BLOWS PER FOOT
- P – HYDRAULICALLY PUSHED
- TV – TORVANE TEST
- UC – UNCONFINED COMPRESSION TEST
- G – SPECIFIC GRAVITY
- C – CONSOLIDATION TEST
- PN – PENETROMETER
- BG – BAG SAMPLE

CLASSIFICATION TERMINOLOGY

DESCRIPTIVE TERM	PERCENT BY WEIGHT
TRACE	0-9
LITTLE	10-19
SOME	20-34
AND	35-50

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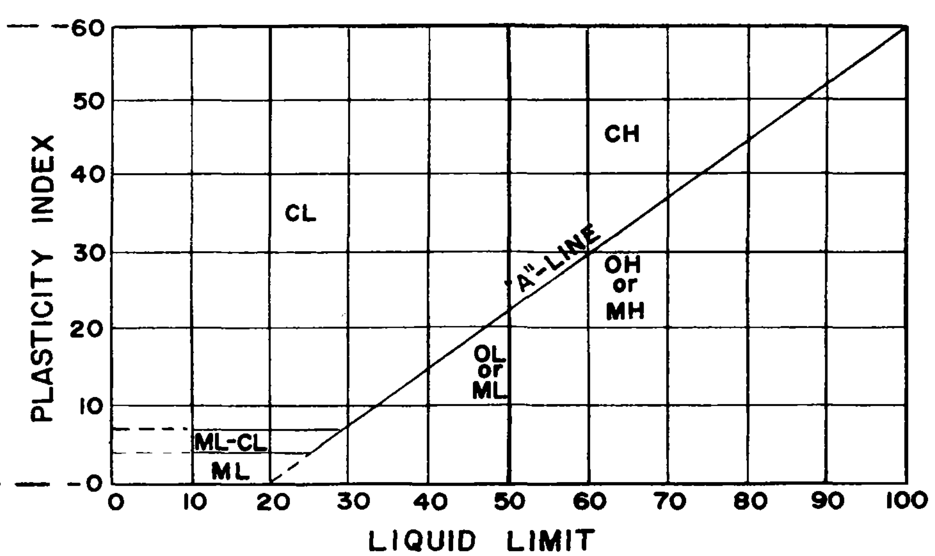
KEY TO LOG OF BORINGS

FIGURE 2

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVEL (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE.	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50 % OF MATERIAL IS LARGER THAN NO. 200 SIEVE				SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE.	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND CLAY MIXTURES.
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE.	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS.
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

GRAPH SYMBOL	LETTER SYMBOL	ROCK CLASSIFICATION
	SH	SHALE
	SI	SILTSTONE
	SS	SANDSTONE
	LS	LIMESTONE

PLASTICITY CHART



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CLASSIFICATION CHARTS

FIGURE 3

BORING M-4d

SURFACE ELEVATION 771.1 ft NGVD
COORDINATE (approximate)
N 48,550
E 25,830

ELEV. IN FEET	OTHER TESTS	Unconfined Compressive Strength (TSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT PASSING #200 SIEVE	RECOVERY (%)	Water Level During Drilling	DEPTH IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
777.1										0				No samples taken from surface to 44 ft; see Log of Boring M-4 for description of soils to 40 ft depth.
									▼ (approx. 34 ft)					
726.6											23	☒	SP-SM	Gray-brown fine to medium SAND, trace to little silt; medium dense; saturated; 2 in. layer of tan, fine to coarse SAND, little to some clay, trace fine to coarse gravel at 44.3 ft.
724.1													ML	Gray SILT, some clay, trace to little sand; very stiff.
											39	☒	SM	Gray and gray-brown fine SAND, little silt, trace to little clay; dense to very dense.
											30	☒		Grades to gray, less clay.
										60				

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

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LOG OF
BORING M-4d

FIGURE 4 SHT. 1 OF 2

BORING M-4d

ELEV. IN FEET	OTHER TESTS	Unconfined Compressive Strength (TSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT PASSING #200 SIEVE	RECOVERY (%)	Water Level During Drilling	DEPTH IN FEET	BLOW COUNT	SYMBOLS	DESCRIPTION
											56		Grades with less silt, more clay.
										65			
											40	SM	Gray fine SAND, trace to little silt.
										70			
											72		Grades to some silt.
695.6										75			
											24		Gray SILT, some clay, trace fine sand; very stiff to hard.
										80			
											25	ML	Grades to little to some clay, trace fine sand; occasional small lens or pod of gray, plastic clay.
										85			
											40		Grades to trace clay, trace to no fine sand.
										90			
677.4											18	CL	Gray SILTY CLAY, trace to little fine to coarse sand, trace fine gravel; hard; damp.
										95			
											32		Boring terminated at 99.0 ft on 11/22/83. Water level encountered at approximately 34 ft during drilling.
672.1		PN=1.75								100			
										105			
										110			
										115			
										120			

Notes:

1. A 2-inch observation well was installed in the borehole with 5 ft of Johnson continuous slot, stainless steel screen set between depths of 66.1 to 71.1 ft. Slot size is 0.006 inch for the lower 2 ft of screen and 0.012 inch for the upper 3 ft of screen. A complete installation summary is given in Table 1 (Revised). Well M-4d is approximately 10 ft southeast of well M-4.

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LOG OF BORING M-4d

FIGURE 4 SHT. 2 OF 2

BORING M-5

SURFACE ELEVATION 723.4 ft NGVD
COORDINATE (approximate)

N 47,910
E 26,215

ELEV. IN FEET	OTHER TESTS	Unconfined Compressive Strength (TSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT PASSING #200 SIEVE	RECOVERY (%)	Water Level During Drilling	DEPTH IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
723.4													SM / CL	Road fill, brown fine SAND and silt, trace clay over gray SILTY CLAY, trace to little fine to coarse sand.
720.4									▼	5	7	☒	ML / SM	Gray and tan SILT and fine sand with seams of medium to coarse sand; yellow-tan fine SAND and silt at 5.5 ft; loose; saturated.
716.9										10	18	☒		Light gray-brown fine SAND, trace to little silt; medium dense, saturated. Color change to tan at 9.0 ft.
										15	26	☒		Grades to trace silt or clay.
										20	14	☒	SP · SM	Grades to trace to little silt or clay, color change yellow-brown to gray.
										25	(9)	☒		
											16	☒		Grades to fine to medium SAND, trace silt.
693.4										30	84	☒		Gray SILT, little to some fine sand, trace clay; extremely dense to medium dense; saturated.
		PN=1.0(shear)								35	24	☒	ML	Grades to less sand, more clay at 35.0 ft.
										40	65	☒		Grades to layered SILT, little fine sand, and SILT, trace to little clay, trace to no sand.
678.4										45	36	☒	CL / ML / SM	Gray SILTY CLAY, trace to little sand, trace fine gravel; hard; moist.
										50	23			Grades to layered SILTY CLAY, gray clayey SILT, and silty SAND.
669.9										55				Boring terminated at 53.5 ft on 11/17/83. Water level encountered at approximately 3.75 ft during drilling.
										60				

Notes:
1. A 2-inch observation well (M-5d) was installed in the borehole with 2 ft of Johnson stainless steel, continuous slot screen set between depths of 29.4 and 31.4 ft. Slot size is 0.006 inch. A complete installation summary is given in Table 1 (Revised).

2. Observation well M-5(s) was installed in a separate borehole 6.3 ft north of M-5d. The well was constructed with 2 ft of Johnson stainless steel, continuous slot screen set between depths of 13.1 and 15.1 ft. Slot size is 0.006 inch. A complete installation summary is given in Table 1 (Revised).

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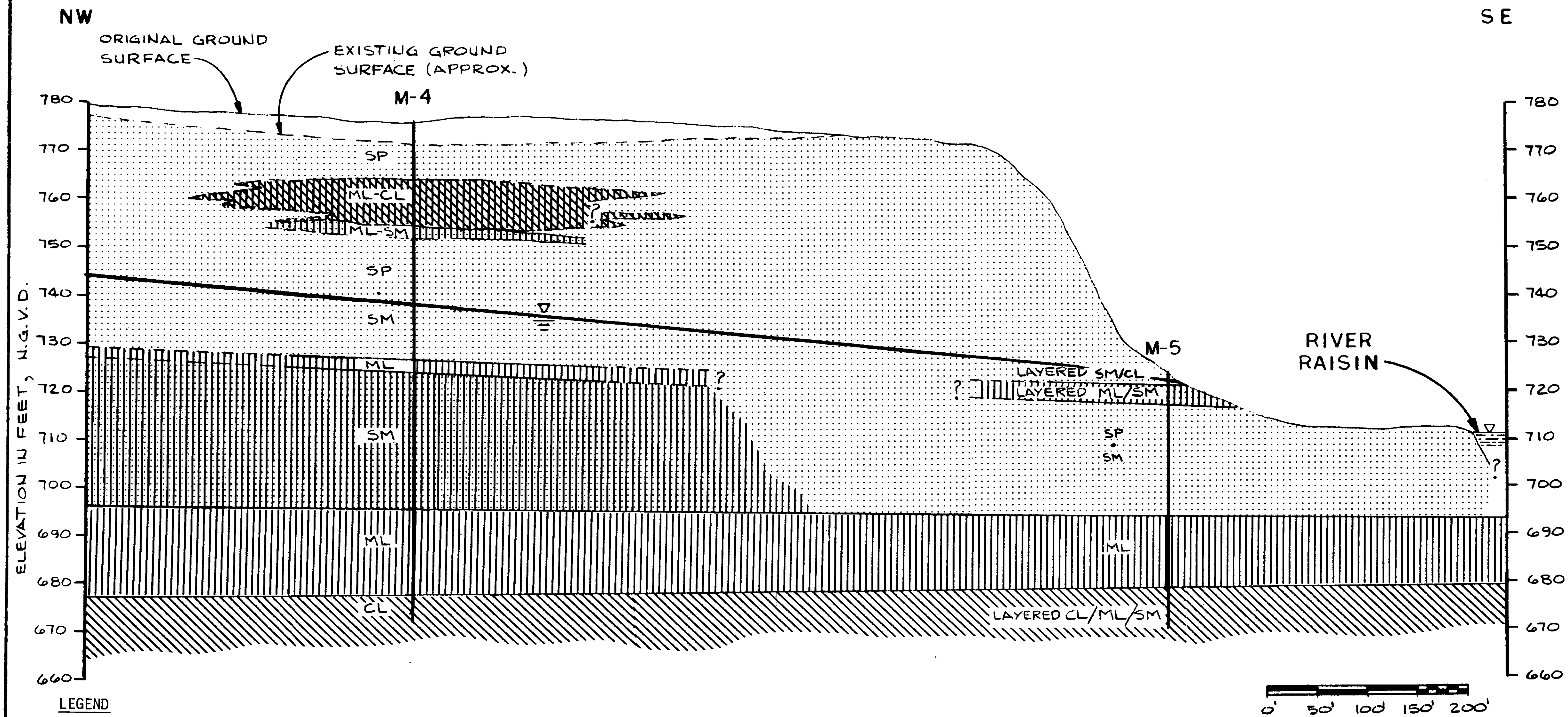
LOG OF
BORING M-5

FIGURE 5



LEGEND

— Contact between major soil types (dashed where uncertain)

▽ Water table

Notes:

1. Profile location shown on Figure 1.
2. Abbreviations for general soil types shown on the profile are described in Figure 3 (Classification Charts).
3. Original ground surface taken from 1964 topographic survey. Topsoil was subsequently removed.
4. Water table profile based upon water levels measured in the observation and monitoring wells on November 23, 1983.

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

GEOLOGIC PROFILE

FIGURE 6

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

RONALD O. SKOOG, Director

December 29, 1983

SWS Silicones Corporation
3901 Sutton Road
Adrian, MI 49221

Attention: Mr. Gordon Philbrook

Re: Buried Barrels

Ladies and Gentlemen:

This is in response to your letter dated December 15, 1983, which was requested to state your intent to comply with our directives contained in my November 29, 1983 letter to your company.

I. Buried Barrels: Removal

You did not state your intent to:

1. Remove and properly dispose of the barrels.

2. Develop and submit by January 31, 1984, a plan and schedule for removal of the buried barrels.

You mention our meeting discussion of September 7, 1983, and assert you "are now prepared to proceed with the installation of an impervious cap over the buried barrels . . . ." as if this Department has approved this concept. Please be aware that although technical discussions at our meeting considered numerous options, staff have not received nor have staff approved any proposals concerning the buried barrels. The Department's position requiring the removal of the buried barrels, stated in our letters to your company dated August 2 and November 29, 1983, has not changed. Your company is again directed to proceed to remove the barrels by developing and submitting a barrel removal plan and schedule by January 31, 1984. Alternate proposals to resolve this problem may also be submitted and will be given consideration.

SUS [illegible]
[illegible] 1983
Page 2

II. Groundwater Restoration Objectives

Your letter did not state your [illegible] with the stated proposed groundwater [illegible] indicate you are ". . . anxious to [illegible] with your office in an objective risk assessment (emphasis [illegible])". Staff's proposed [illegible] for recommendation to the Water Resources Commission have not changed.

III. Buried Barrels: Information

We are pleased that the company is [illegible] to provide requested other items by January 31, 1984. As Mr. [illegible] discussed with you on December 28, 1983; after we have received the above mentioned items, an informal staff meeting can be arranged. However, it is premature to set up a meeting now.

If you have any questions or comments, please do not hesitate to contact Mr. Babcock.

Sincerely,

[illegible]

Steve [illegible]
Jackson District Supervisor
Surface Water Quality Division
(517) [illegible]-9598

[illegible]

cc: F. Baldwin
R. Beach
L. Duling
R. Elmroth
V. Harris
J. Larsen
L. Rowell

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

December 15, 1983

State of Michigan DNR
Surface Water Quality Division
4th Floor
Jackson State Office Bldg.
301 E. Louis B. Glick Hwy.
Jackson, MI 49201

Attn: Mr. Steve Eldredge
Jackson District Supervisor

Re: SWS Silicones Corporation
Buried Barrels

Dear Sirs:

Please refer to your letter to SWS, dated November 29, 1983. As you know, we met with you and your staff on September 7, 1983. At that time we discussed, and are now prepared to proceed with, the installation of an impervious cap over the buried barrels. We are surprised by your November 29, 1983 letter, and the fact that we have had no other communication with you since our September 7th meeting.

SWS believes additional information can be generated between now and January 31, 1984 which will identify appropriate remedial action. SWS will submit the information outlined in your letter by January 31, 1984, regarding the barrels and the wastes they contain, as well as hydrogeological information being generated, now.

SWS believes any decision on remedial action should await the submission of the current data which you requested, plus additional hydrogeological and analytical data, which SWS has developed since the September 7, 1983 meeting. SWS is anxious to cooperate with your office in an objective risk assessment for this site. We would like to meet with you and your staff after the submission of current data, in mid to late January 1984. Please contact me at your early convenience, so that we may meet with you in January 1984.

Sincerely,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 83-248, certified

cc: L. B. Bruner
J. Calamungi
L. Duling, MDNR, Lansing - certified
E. E. Eltzroth, MDNR, Jackson - certified

STATE OF MICHIGAN

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

RONALD O. SKOOG, Director

Reply To:

4th Floor
Jackson State Ofc. Bldg.
301 E. Louis Glick Hwy
Jackson, MI 492

November 29, 1983

SWS Silicones Corporation
P.O. Box 428
3901 Sutton Road
Adrian, MI 49221

Attention: Mr. Gordon Philbrook

Re. Buried Barrels

Ladies and Gentlemen:

This letter is intended to state the Michigan Department of Natural Resources position regarding the barrels buried on SWS Silicones plant property.

Buried Barrels

Seepage of waste materials from these barrels to the groundwater constitute an unauthorized discharge to the waters of the State. This discharge is in violation of Sections 6. (a) and 7. (1) of the Michigan Water Resources Commission Act, Act 245, Public Acts of 1929, as amended. It is necessary these barrels be removed and properly disposed of to remedy this situation.

The company is directed to provide the following information regarding these barrels:

1. A plan and schedule for removal and proper disposal of the barrels. The schedule, submitted for our approval, should provide for barrel removal as soon as possible.
2. The process which generated the wastes.
3. A description of the wastes including chemical name, concentration and total volume.
4. The reason for utilizing this method of "disposal".
5. The number of barrels buried.
6. A description of the burial practice (depth of excavation, amount of cover, etc.).

7. A description of the burial location.

8. The projected chemical composition of the wastes currently, if expected to be other than as buried.

9. Environmental concerns associated with barrel removal.

10. Recent monitoring well data.

This information is to be provided to the DNR no later than January 31, 1984.

Groundwater Quality Restoration

Staff has reviewed the hydrogeologic investigation submitted by the company as required in Part I. C.3 of the NPDES permit. As a result, staff is prepared to recommend to the Water Resources Commission that there exists an "unacceptable risk to public health, safety, and welfare, or to any uses made or to be made of the surface or groundwater of the state" (NPDES permit, Part I. C.3 c). Further, staff will recommend to the Water Resources Commission a restoration program be initiated with the following objectives:

1. Further migration of contaminated groundwater be prevented.

2. Contaminated groundwater be restored to background quality in as short a time as possible.

These recommendations are based on information currently available to staff. The company may submit additional data for consideration in evaluating the objectives. Staff intends to present these recommendations to the Water Resources Commission at its March 1[illegible], 1984, meeting. Additional information the company may wish to submit should be received by the DNR not later than January 31, 1984, to allow review prior to the meeting.

Commission acceptance of these recommendations will require the company to proceed with a groundwater restoration program in accordance with the schedule in Part I. C.3 of the NPDES permit. To develop the required restoration plan additional hydrogeologic information is needed. The company should work with [illegible]altzroth (DNR, Groundwater Quality Division) in obtaining this information and in developing a restoration plan.

You are directed to inform us by December [illegible], 1983, of your intent to comply with the directives of this letter, namely

1. Removal and proper disposal of the buried barrels.

2. Submission of information by January 31, 1984, concerning the barrels and the wastes they contain and a plan and schedule for their removal.

3. Submission of additional data concerning the groundwater restoration objectives by January 31, 1984.

Sincerely,

Steve Eldredge

Steve Eldredge
Jackson District Supervisor
Surface Water Quality Division
(517) 788-9598

SE:dl

cc: T. Baldwin, SWQD
R. Jasch, WMD, Lansing
L. Duling, ESD
E. Eltzroth, GWQD, Jackson
V. Harris, EED
J. Larsen, AQD, Jackson
L. Rowell, EED

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

July 22, 1983

TO: Steve Eldredge

FROM: Robert F. Babcock RFB

SUBJECT: SWS Silicones Corporation (NPDES Permit MI 0026034) Drum Burial Staff Meeting

This is to confirm the staff meeting held on July 12, 1983, at 9:00 a.m. at Westland. Meeting participants were Linn Duling (TCES), Lyle Rowell (EED), Greg Danneffel (Groundwater Quality Division, Jackson), and Steve Eldredge and myself (Surface Water Quality Division--Jackson).

<u>Summary</u>

It is determined that ". . . an unacceptable risk to public health . . .") NPDES permit Part I C.3.c. does exist in the groundwaters near the company's "old drum burial site". This determination was based on the toxicological evaluation that three of the five identified chlorinated organics are carcinogens, and that four of the five of these substances are shown in the groundwater at levels in excess of TCES's recommended limits (ref. L. Duling 7-14-83 memo attached).

The company will be informed of our determination (by August 1, 1983) that an unacceptable risk does exist and that a restoration program is required. The restoration program must consist of at least the following:

1. Removal and proper disposal of buried drums.

2. Evaluate and remove contaminated soils adjacent to drums and above saturated zone of groundwater (pp. 146-157 Soil Sampling, <u>Quality Assurance for Water and Sediment Sampling</u>).

3. Provide further hydrogeological information to delineate vertical and horizontal extent of contaminants in the groundwater.

4. Purge the groundwater to required quality.

The company will be required within 30 days of receipt of our "unacceptable risk exists" letter to submit an acceptable drums and soils removal program which shows that the drums and soils will be acceptably removed and disposed of as soon as possible but by no later than October 15, 1983.

The company shall submit an approvable plan for groundwater restoration to meet the department's objectives in accordance with NPDES permit Part I C.3. That is, in the Department's "unacceptable risk exists" letter, the company will be informed of the limits for a temporary surface water discharge, as well as ultimate groundwater quality objectives. The company will then proceed to comply with the NPDES permits remaining elements in this matter: (Part I C.3.c. through f.)

1. Groundwater restoration plan submittal and approval within 120 days. (c.)

2. Certification of initiation of groundwater restoration program within 180 days of approval. (d.)

3. Submit quarterly progress reports following start up of groundwater restoration. (e.)

4. Certification of achievement of objectives of groundwater restoration program. (f.)

Note: Subsequent review of the NPDES permit text and discussion with Frank Baldwin reveals that the Water Resources Commission will need to make the "unacceptable risk exists" determination. The letter to the company by approximately August 1, 1983 will advise them of this recommended Commission action, offer a meeting with staff, and require the drums and soils to be removed as soon as possible, but no later than October 15, 1983.

Attachment to All
cc: E. Eltzroth/G. Danneffel
J. Grant/L. Duling
L. Rowell
J. Larsen
F. Baldwin
R. Schrameck

ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 265-5711

February 24, 1983

Chief Engineer
Michigan Department of Natural Resources
Surface Water Quality Division
P. O. Box 30028
Lansing, Michigan 48909

Re: SWS Silicones Corporation, NPDES Permit MI 0026034, Hydrogeological Investigation

Gentlemen:

This letter responds to Special Condition number 6 (six) of our NPDES permit, and is a submittal of findings concerning the Hydrogeological Investigation of the "old drum burial site" area of our plant.

Please refer to our letter to the Department of Natural Resources dated September 10, 1982 and to the letter from R. E. Schrameck of the Department of Natural Resources dated November 9, 1982.

Attached is the following data:

1. Stauffer inter-office memo from B. S. McClellan, Senior Hydrogeologist, dated 2/14/83, and entitled "Estimate of Mass Loading, Phase II Hydrogeologic Investigation, Old Disposal Area, SWS, Adrian, Michigan."

2. Table I, "M-Well Analysis," which is the result of sampling the four "M" wells on January 5, 1983.

3. Gilbert/Commonwealth study, dated August, 1982, and entitled "Hydrogeologic Investigation of Disposal Area, SWS Silicones Corporation, Adrian, Michigan." Note that portions of this report were submitted to the Department of Natural Resources in our September 10, 1982 letter.

This report completes the phase II Hydrogeological Investigation required by our NPDES permit. Please refer to our letter dated December 23, 1982, concerning the findings of the evaporation-settling pond portion of this study.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 83-30, certified

cc: J. Calamungi
S. Eldredge, DNR, Jackson District; certified
B. S. McClellan*
T. J. Sayers*
R. E. Schrameck, DNR, Grosse Ile; certified*
*No G/C report

Stauffer

INTER-OFFICE CORRESPONDENCE

Westport

Adrian

G.C. Philbrook

cc: J. Calamungi
G.L. Ford
D. McGrade
T.J. Sayers

B.S. McClellan
Sr. Hydrogeologist

2/14/83

Estimate of Mass Loading
Phase II Hydrogeologic
Investigation
Old Disposal Area, SWS
Adrian, Michigan

This report presents an estimate of mass loading from the old disposal area to the river. This work has been conducted in response to a request for calculation of the "flow volume of the affected ground water" and "a projection of the anticipated spread through the ground" made in the November 9, 1982 letter from R.E. Schrameck of Michigan DNR.

The data presented in this report is based on information provided in the August, 1982 report Hydrogeologic Investigation of Disposal Area, prepared by Gilbert/Commonwealth and the results of analyses performed on ground-water samples collected from the "M" series wells on January 5, 1982. The August, 1982 report by Gilbert/Commonwealth was previously submitted to the Michigan DNR in September, 1982 and is here after referred to as the G/C report. The January, 1983 analytical results are attached.

In order to estimate the mass loading it was necessary to estimate the discharge rate (volume/unit time) of ground water which flows past and under the disposal area and discharges to the river or adjoining swampy flood plain area. The discharge rate was estimated using the expression

$$Q = KIA$$

Where:

Q = discharge rate in unit volume per unit time
K = the hydraulic conductivity
I = the hydraulic gradient
A = the cross-section area through which flow occurs

The hydraulic conductivity and hydraulic gradient are provided in the G/C report and are 6.0×10^{-3} cm/sec and 0.019 respectfully. The cross-sectional area was determined by calculating the area of a vertical plane in the upper ten feet of the saturated zone, downgradient of the disposal area and perpendicular to the observed ground-water flow direction. Using Figure 2 of the G/C report as a reference, this vertical plane is located along a line which intersects well M-3 and a point located approximately 169 feet downgradient of well M-2 at the Figure 2 grid intersection N 48,356 and E 25,689.

1 C 1983

Based on the observed concentrations the maximum spread of contamination appears to be about 400 feet. That is to say, the width of the plume downgradient of the disposal area at the vertical plane is about 400 feet. The plume width or outer limit is defined by the groundwater flow lines which pass through wells M-2 and M-3, and intersect the vertical plane.

The flow lines which pass through M-2 and M-3 are considered to represent the outer limits of the plume based on the observed concentration in the three downgradient wells. The elevated concentrations were observed in well M-4, the center well. In both M-2 and M-3 only one chemical found in M-4 was detected. The detections in M-3 and M-2 were two to three orders of magnitude less respectfully. Based on the ground water contouring on Figure 2 of the G/C report it appears that the width of this plume does not change significantly prior to discharge along the river flood plain.

Using this maximum plume width the cross-sectional area through which ground water passes is about 4,000 square feet. Plugging this cross-sectional area into the expression above the ground-water discharge rate is approximately 9,659.6 gpd.

To compute the estimated mass loading the concentrations for each chemical in each of the three downgradient wells was averaged. The resulting mass loading in pounds per day is shown in Table 1.

TABLE 1

Estimated Mass Loading

Chemical	Average Concentration Mg/L	Mass Loading Pounds Per Day
1,1 dichloroethane	0.053	0.004
t,1,2 dichloroethylene	0.345	0.028
1,1,1 trichloroethane	0.650	0.052
trichlorothylene	0.247	0.020
tetrachloroethylene	0.060	0.005
Total Chlorinated Organics	1.355	0.109
trimethyl silanol	5.017	0.401

Considering that the chemical concentrations observed and number of detections made in the ground-water sample from M-4 was significantly greater than the other wells, an estimate of mass loading using the concentrations detected in well M-4 was also computed. Based on the distribution of concentrations observed in the three downgradient wells, the greater concentrations are considered representative of ground water in the immediate area (50 feet radius) of M-4. For this reason the width of the plume of greater concentration has been assumed to be 100 feet wide. Using the assumed plume width the estimated ground-water discharge rate is approximately 2,414.9 gpd. The resulting mass loading in pounds per day for the area around M-4 is shown in Table 2.

TABLE 2

Estimated Mass Loading
(Concentrations At M-4)

Chemical	Concentration M-4 Mg/L	Mass Loading Pound Per Day
1,1 dichloroethane	0.16	0.003
t,1,2 dichloroethylene	1.02	0.020
1,1,1 trichloroethane	1.95	0.039
trichloroethylene	0.74	0.015
tetrachloroethylene	0.18	0.004
Total Chlorinated Organics	4.05	0.081
trimethyl silanol	15.0	0.300

Once again based on the observed ground-water flow condition, it should be anticipated that the width of the plume at the measuring point used in this report and at the discharge area should be the same.

If you have any questions please call.

B.S. McClellan

BSM018:dm

Attachment

SWS SILICONES CORPORATION

Table I

M Well Analysis

The results from the analysis of the four "M" well samples collected on January 5, 1983 are as follows:

	mg/l			
	[redacted]	[redacted]	[redacted]	[redacted]
1,1 dichloroethane	N.D.	N.D.	N.D.	0.16
t-1,2 dichloroethylene	N.D.	N.D.	0.02	1.02
1,1,1 trichloroethane	N.D.	N.D.	N.D.	1.95
trichloethylene	N.D.	N.D.	N.D.	0.74
tetrachloroethylene	N.D.	N.D.	N.D.	0.18
trimethyl silanol	N.D.	0.05	N.D.	15
TOC	--	--	--	30

1. We also did analyses of spiked samples. The results were 18% to 58% higher than the theoretical values for all the hydrocarbons, except for tetrachloroethylene, which were 19% to 48% lower than the theoretical values.

2. Refer to letter dated September 10, 1982 for other analyses.

G. C. Philbrook

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

December 23, 1982

Chief Engineer
State of Michigan
Department of Natural Resources
Water Quality Division
P. O. Box 30028
Stevens T. Mason Building
Lansing, Michigan 48909

Re: SWS Silicones Corporation
NPDES Permit MI 0026034

Gentlemen:

This letter concerns Special Condition Number Six (6) of our NPDES permit, and is a report summarizing our findings of the DNR-approved Phase II Hydrogeologic Study Plan for the old evaporation-settling pond.

Please note that the pond has been out of service since May, 1980. The pond has since been drained, closed, and capped in accordance with the DNR-approved plan, and in compliance with Special Condition Number Seven (7) of our NPDES permit.

The following information is enclosed:

1. Gilbert/Commonwealth report entitled "Permeability Testing of OW-Series Observation Wells for SWS Silicones Corporation, Adrian, Michigan".
2. Gilbert/Commonwealth report entitled "Ground Water Flow Beneath the Sealed Evaporation and Settling Basin at SWS Silicones Corporation, Adrian, Michigan".
3. Summary Table of Well analyses for June 9, July 21, and August 11, 1982.
4. Inter-office memo from B. S. McClellan, dated December 20, 1982, entitled "Estimate of Mass Loading, Phase II Hydrogeologic Investigation, Evaporation and Settling Basin, Adrian".

This report concludes our study of the evaporation-settling pond portion of the Phase II Hydrogeological Investigation.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 82-377, certified

cc: R. Schrameck, MDNR, District #1, certified
J. Calamungi

Stauffer CHEMICALS

INTER-OFFICE CORRESPONDENCE

Westport

TO LOCATION: Adrian

FROM: B.S. McClellan
Sr. Hydrogeologist

DATE: 12/20/82

ATTENTION: G.C. Philbrook

SUBJECT: Estimate of Mass Loading, Phase II Hydrogeologic Investigation, Evaporation and Settling Basin, Adrian

COPY TO: J. Calamungi
G.L. Ford
D. McGrade
T.J. Sayers

This report presents an estimate of mass loading from the basin to the river. This estimate is based on my review of the information obtained during the Phase II Hydrogeologic Investigative work performed in regards to the now closed Evaporation and Settling Basin. Specifically I have reviewed two reports by the outside contractor Gilbert/Commonwealth.

1. Report No. 1 - Permeability Testing of OW-Series Observation Wells For SWS Silicones Corporation

2. Report No. 2 - Ground-Water Flow Beneath the Sealed Evaporation and Settling Basin at SWS Silicones Corporation, Adrian, Michigan

Also reviewed were the results of chemical analysis performed by SWS Silicones Corporation on samples collected from the nine observation wells on June 9, 1982, July 21, 1982 and August 11, 1982.

The purposes of this work has been to obtain the information needed to estimate the mass loading (in pounds per unit time) to the river from the basin area via ground-water discharge from the "Perched and Near Surface Aquifers." Based on the work conducted the estimated cumulative total mass loading for the chlorinated organic chemicals analyzed was 0.502 pounds per day from the "Perched Aquifer" and 0.003 pounds per day from the "Near Surface Aquifer." Ground-water in the "Perched Aquifer" (shallow) discharges along the upland slope to the floodplain swampy area and from the "Near Surface Aquifer" (deeper) to the floodplain swampy area and the River Raisin.

Discussion of Methods Used

Ground-Water Discharge Rate: The ground-water discharge rate was determined by Gilbert/Commonwealth for both the "Perched Aquifer and Near Surface Aquifer." In order to accomplish this it was necessary to determine the in-site permeability of the soil contained in each saturated zone and construct a structural/hydrogeologic model of the site from which the dimensions of ground-water flow could be determined. The work performed and conclusion reached are described at depth in Reports No. 1 and No. 2. In Report No. 2 Gilbert/Commonwealth has presented a discharge rate of 3359 gpd for the "Perched Aquifer" and 2558 gpd for the "Near Surface Aquifer." These discharge rates represent the volume of ground water per unit time that will pass through a cross-sectional area situated downgradient of the basin and are representative of flow in the aquifers beneath the basin.

FORM 0032-000-00A

SAFEGUARD COMPANY INFORMATION

Chemical Analysis: Ground-water samples from the existing OW-Series wells were analyzed by SWS Silicones for the proposed list of chemicals. Samples were collected on June 9, 1982, July 21, 1982 and August 11, 1982. Using the analytical results from wells 1S, 1D, 4S and 4D (S-perched aquifer and D-near surface aquifer) an average concentration for each chemical in ground-water downgradient from the basin in each aquifer was obtained. Table 1 shows the actual analytical results for each compound, on each date sampled, for the downgradient wells and the average concentration obtained.

TABLE 1

Perched Aquifer

Chemical - mg/L	Well No./Date Sample 1S 6/9	1S 7/21	1S 8/11	4S 6/9	4S 7/21	4S 8/11	Average Concentration Mg/L
TOC	30	900	1000	20	34	360	390.7
Hydrolyzable (Ionic or Non-Organic) Chlorides	950	1600	2157	1280	1390	1978	1559.2
1,1,1-Tri-chloroethane	3.7	5.5	6.9	3.0	2.5	3.6	4.2
1,1-Dichloro-ethane	17.0	28.0	36.0	N.D.	0.4	0.35	13.6
t-1,2-di-chloroethylene	N.D.	N.D.	N.D.	0.8	0.03	0.03	0.14
Di-n-butyl phthalate	≤ 0.025	--	--	N.D.	--	--	0.013

TABLE 1 - (Continued)

Near Surface Aquifer

Chemical - mg/L	Well No./Date Sampled						Average Concentration mg/L
	1D			4D			
	6/9	7/21	8/11	6/9	7/21	8/11	
TOC	13	--	100	8	8	11	28.0
Hydrolyzable (Ionic or Non-Organic) Chlorides	855	--	1180	273	235	249	558.4
1,1,-Trichloro-ethane	0.13	--	0.12	0.08	0.06	0.18	0.11
1,1-Dichloro-ethane	N.D.	--	N.D.	N.D.	N.D.	N.D.	N.D.
t-1,2-Dichloro-ethylene	N.D.	--	N.D.	0.04	0.05	0.16	0.05
Di-n-butyl phthalate	N.D.	--	--	N.D.	--	--	N.D.

Mass Loading Determination: Using the average concentration for each compound (mg/L) in each aquifer and the discharge rate for each aquifer (Liters/day) an estimate of the mass loading for each compound (pounds per day) in each aquifer was obtained. The results of this determination are presented in Table 2 along with the cumulative totals for chlorinated organics. It is important to note that in making this determination no consideration was given to the attenuative capabilities of the water bearing soils or the hydrolytic stability of the compounds involved. Therefore, the results presented here should be viewed as a worst case situation and the actual amounts of the observed compound reaching the discharge areas could be significantly less.

TABLE 2

Mass Loading Determination Lb./day

Compound	Perched (Shallow) Aquifer	Near Surface (Deeper) Aquifer
TOC	10.9	0.6
Hydrolyzable (Ionic or Non-Organic) Chlorides	43.6	11.9
1,1,1-Trichloro-ethane	0.118	0.002
1,1-Dichloro-ethane	0.380	N.D.
t-1,2-Dichloro-ethylene	0.004	0.001
Di-n-butyl Phthalate	< 0.001	N.D.
Chlorinated Organics Cumulative Totals	0.502	0.003

Conclusions

1) I believe that the representation of hydrogeologic conditions presented by Gilbert/Commonwealth are reasonably accurate. Furthermore, because of the relatively high permeability values used for the type of materials described and the recent elimination of the Evaporation and Settling Basin as a source of recharge, I believe that the ground-water discharge rates presented are on the high side. Based on this I do not predict significantly higher values for discharge than those used here.

2) Given that the Evaporation and Settling Basin is now closed and caped the mass loading determinations presented here should be considered a high point. The elimination of the basin as a potential source of recharge to the "Perched Aquifer" should result in a reduction of mass loading values presented here.

3) When considering the mass loading values presented here it is important to keep in mind that this discharge does not occur from a point source but is spread out over a significant area as shown on Figure 5 and 6 of Report 2 by Gilbert/Commonwealth. Also discharge is not directly to the river but to a swampy area and it is questionable as to how much if any of the estimated mass loading reaches the river.

If you have any questions please call.

B.S. McClellan

B.S. McClellan

BSM005:dm

SWS SILICONES CORPORATION

TABLE I

Old Evaporation Pond, Well Analyses

For June 9, July 21 and August 11, 1982

mg/l

Well #	T.O.C. 6/9	T.O.C. 7/21	T.O.C. 8/11	Chloride 6/9	Chloride 7/21	Chloride 8/11	di-n-butyl-phthalate 6/9
1S	30	900	1000	950	1600	2157	≤ 0.025
1D	13	100	(1)	855	1180	(1)	ND(2)
2S	29	28	24	440	410	547	ND(2)
2D	5	(1)	(1)	240	(1)	(1)	≤ 0.030
3S	14	13	14	190	400	537	ND(2)
3D	5	7	6	174	250	239	≤ 0.025
4S	20	34	360	1280	1390	1978	ND(2)
4D	8	8	11	273	235	249	ND(2)
5	14	16	18	370	370	403	ND(2)

Well #	1,1,1 trichloroethane 6/9	1,1,1 trichloroethane 7/21	1,1,1 trichloroethane 8/11	t-1,2-dichloroethylene 6/9	t-1,2-dichloroethylene 7/21	t-1,2-dichloroethylene 8/11	1,1 dichloroethane 6/9	1,1 dichloroethane 7/21	1,1 dichloroethane 8/11
1S	3.7	5.5	6.9	ND	ND	ND(3)	17	28	36
1D	0.13	0.12	(1)	ND	ND	(1)	ND	ND	(1)
2S	0.25	0.40	0.61	0.74	0.65	0.67	ND	ND	0.01
2D	ND	(1)	(1)	ND	(1)	(1)	ND	(1)	(1)
3S	0.30	1.0	1.7	ND	ND	0.01	ND	ND	0.01
3D	ND	ND	ND	ND	ND	ND	ND	ND	ND
4S	3	2.5	3.6	0.80	0.03	0.03	ND	0.40	0.35
4D	0.08	0.06	0.18	0.04	0.05	0.16	ND	ND	ND
5	0.25	0.20	0.31	0.14	0.25	0.40	ND	ND	ND

(1) Insufficient water for sampling.
(2) Detection limit about 0.02 mg/l.
(3) Detection limit about 1.0 mg/l in this sample.
(4) Other ND (None Detected) limits about 0.01 mg/l.

G. C. Philbrook
12-22-82

GROUND WATER FLOW BENEATH
THE SEALED EVAPORATION AND
SETTLING BASIN
AT
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Prepared by:

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GROUND WATER FLOW BENEATH THE SEALED EVAPORATION AND SETTLING BASIN AT SWS SILICONES CORPORATION ADRIAN, MICHIGAN

INTRODUCTION

During the summer of 1982, SWS Silicones Corporation (SWS) removed from service and sealed over an evaporation and settling basin located in the southeast portion of their plant site near Adrian, Michigan. Commonwealth Associates Inc. (Commonwealth) was retained in October 1982 to determine the quantity of ground water passing beneath the basin. The results of Commonwealth's investigations, analytical procedures and data and assumptions used in the analysis are presented in this letter report.

EXISTING HYDROGEOLOGIC CONDITIONS

Soil Sequence

Logs of the B-series and OW-series borings were reviewed to establish the soil sequence in the vicinity of the evaporation and settling basin. These logs were originally presented in Commonwealth Report R-2194, "Hydrogeologic Study for Evaporation and Settling Basin." Boring locations are shown on Figure 1, Site Topography and Plot Plan, along with the configuration of the evaporation and settling basin before sealing.

Subsurface geologic profiles through the basin area are shown on Figures 2 and 3. To construct the profiles, contour maps were first prepared for the four major soils changes indicated on the boring logs. Profiles of the contacts between soil types were then developed by superimposing the profile lines shown on Figure 1 onto each contour map. The different soil types on the boring logs and profiles are based upon the Unified Soil Classification System, which is described on Figure 4.

In descending order, the soil sequence shown on the profiles consists of an upper sand layer (SW·SM), very fine sand and organic silt (ML), silty clay (CL), a second layer of very fine sand and silt (ML), and a lower layer of sand (SP·SM). The base of the lower sand layer is not shown because the borings were terminated in this layer. All of the layers present in the basin area were assumed to be continuous to the river bluff. The assumed sequence of upper floodplain soils on all three profiles is based upon soils encountered in boring OW-5.

Ground Water Flow Systems

As documented in Commonwealth Report R-2194, two ground water flow systems occur in the upper 40 feet of unconsolidated soils in the vicinity of the evaporation and settling basin. The upper sand (SW·SM) and silt (ML) comprise the shallow aquifer while the lower silt (ML) and sand (SP·SM) comprise the deep aquifer. In the 1980 report, these aquifers were labeled "perched" and "normal," respectively. Soils immediately below the silty clay layer were unsaturated, indicating that the CL layer acts as a confining layer between the two aquifers.

A pair of observation wells was installed at four locations in the basin area during June 1980 to permit periodic measurements of ground water levels in the shallow and deep aquifers. A ninth observation well was installed at the northern edge of floodplain deposits along the River Raisin (Figure 1). Ground water levels recorded for both aquifers are summarized in Table 1.

Ground water contours for the shallow and deep aquifers on October 15, 1982 are shown on Figures 5 and 6, respectively. Flow lines drawn orthogonal to the contours illustrate the direction of ground water flow in each aquifer. Ground water in the shallow aquifer beneath the former evaporation and settling basin is moving to the south and southeast under an average gradient of approximately 0.027 (27 feet in 1,000 feet). Ground water in the deep aquifer, however, is flowing entirely to the southeast under an average gradient of approximately 0.019. Water table profiles shown on Figures 2 and 3 reflect the water levels measured on October 15, 1982. As shown on Figures 2 and 3, water in the shallow aquifer discharges along the slope from the upland to the floodplain while water in the deep aquifer discharges to the floodplain swamp and the River Raisin.

Based upon contour maps plotted (but not shown here) for July 1, 1980 and May 26, 1982, ground water flow directions in both aquifers have not changed substantially since the observation wells were first installed. In fact, ground water contours for the deep aquifer on July 1, 1980 are virtually identical to those shown on Figure 6. Deep aquifer contours for May 26, 1982 have the same orientation, but reflect water levels 1 to 2 feet higher than those measured on October 15, 1982. The same relationships do not hold, however, for the shallow aquifer. Although the shallow aquifer contours for July 1, 1980 and May 26, 1982 are nearly the same, ground water levels measured on both dates are 3 to 4 feet higher than water levels measured on October 15, 1982. Also, the contours shown on Figure 5 are less strongly curved than those for either of the previous dates.

Soil Permeabilities

Permeability values to be used in calculating discharge from the shallow and deep aquifers were established from field permeability tests conducted by Commonwealth in six observation wells around the evaporation and settling basin. Permeability test results were summarized in a previous letter report dated October 14, 1982.

Recommended permeability values for the upper sand (SW·SM) and lower sand (SP·SM) layers are 2.0×10^{-2} cm/sec and 3.0×10^{-3} cm/sec, respectively. These values correspond to 57 ft/day for the upper sand and 8.5 ft/day for the lower sand. Based upon the test results for well OW-3s, the permeability of the sandy silt (ML) is 2.5×10^{-3} cm/sec (7.1 ft/day). This well is screened entirely within the upper ML layer. Since the silt (ML) layer of the deep aquifer was not tested, the permeability is assumed to be the same as for the upper ML layer.

DISCHARGE ANALYSES

Theoretical Basis

Commonwealth was requested to calculate the quantity of ground water reaching the River Raisin or adjacent swamp that also passes beneath the sealed evaporation and settling basin. The computations described herein are based upon ground water flow (potential) theory and the law of mass conservation.

According to the theory of ground water flow, lines drawn orthogonal to equipotential lines (ground water contours) represent impermeable boundaries across which flow does not occur. The area between any two flow lines is called a flow channel. By the law of mass conservation, the quantity of ground water moving in any particular flow channel must be constant unless water is added from an outside source (recharge) or is removed from the flow channel (discharge). For these calculations, it was assumed that there is no recharge to or discharge from either the shallow or deep aquifer in the basin area. This is a reasonable assumption because the cooling lagoons south of the evaporation and settling basin are fully lined.

Analytical Procedures

On Figures 5 and 6, the outer flow lines for each aquifer have been drawn to encompass the evaporation and settling basin in a single flow channel. The quantity of water reaching the bluff or swamp that also passes beneath the basin may be calculated from the relation

$$Q = KiA \qquad \text{(Equation 1)}$$

In this form of Darcy's law, Q is the discharge rate in cubic feet per day (ft^3day), K is the hydraulic conductivity (permeability) of the saturated materials in ft/day, i is the dimensionless hydraulic gradient, and A is the cross-sectional area normal to the direction of flow. The parameter A may also be written

$$A = mL \qquad \text{(Equation 2)}$$

where m is the saturated thickness of the aquifer and L is the length of any equipotential line between the outer flow lines. Both m and L are in feet (ft).

It was previously established that, in the absence of recharge or discharge, the discharge rate, Q, is constant throughout the length of any flow channel. Therefore, Q will be the same whether it is calculated at the bluff or the edge of the evaporation and settling basin. An arbitrary equipotential line between the outer flow lines and tangent to the southeast corner of the former basin was selected as the line across which the discharge rate would be calculated for each aquifer. This equipotential is indicated on Figures 5 and 6 by a heavy dashed line. Values of k, m, and i are relatively well known at these locations.

As indicated by the geologic profiles and water level measurements in the observation wells, ground water is moving through both the sand and silt layers in each aquifer. Total aquifer discharge, Q_T, is the sum of discharge through the sand layer, Q_{sd}, and discharge through the silt layer, Q_{st},

$$Q_T = Q_{sd} + Q_{st} \qquad \text{(Equation 3)}$$

Darcy's law applied to each layer yields

$$Q_{sd} = (K_{sd})(m_{sd})iL \text{ and} \qquad \text{(Equation 4A)}$$

$$Q_{st} = (K_{st})(m_{st})\,iL \qquad \text{(Equation 4B)}$$

Substituting Equations 4A and 4B into Equation 3 results in

$$Q_T = [(K_{sd})(m_{sd}) + (K_{st})(m_{st})]iL \qquad \text{(Equation 5)}$$

Calculations

Permeability and hydraulic conductivity values to be used in the discharge calculations are provided earlier in this report. The parameter L is the length of the dashed equipotential line shown on Figures 5 and 6. L is 300 feet for the shallow aquifer and 279 feet for the deep aquifer.

A three-step process was used to establish the saturated thicknesses, m, of all layers except the lower sand. First, profile lines A-A', B-B', and C-C' (Figure 1) were superimposed on the ground water contour maps to locate the point where the dashed equipotential line crosses the profile lines. Next, the saturated thicknesses at that point were determined from the profiles. On October 15, 1982, the saturated thickness ranged from 0.0 to 0.5 ft for the upper sand, 2.5 to 8.5 ft for the upper silt, and 5.0 to 6.0 ft for the lower silt. Finally, values of m were averaged for each layer to obtain a single value for use in the calculations.

The saturated thickness of the lower sand cannot be determined from existing data. A value may be estimated, however, based upon an understanding of ground water flow theory. According to the theory, vertical (upward) components of flow associated with discharge areas would prevent convective mixing of ground water between the upper and lower portions of the aquifer. Available data indicate that ground water in the deep aquifer is discharging to the floodplain swamp and River Raisin. Therefore, the effective saturated thickness for computing the quantity of ground water affected by the evaporation and settling basin would be less than the total saturated thickness of the aquifer. An effective saturated thickness of 3 feet has been assumed for the lower sand. If a different value can be shown to be more appropriate, the daily discharge from the deep aquifer can be readily computed by substituting the new value for m_{sd} into Equation 5.

For the shallow aquifer, the discharge rate from the flow channel shown on Figure 5 was calculated using the following values for K, m, i, and L:

$K_{sd} = 57$ ft/day	$K_{st} = 7.1$ ft/day
$m_{sd} = 0.2$ ft	$m_{st} = 6.2$ ft
$i = 0.027$	$L = 300$ ft

Substitution of these values into Equation 5 yields

$$Q_T = 449 \text{ ft}^3\text{/day (3359 gallons/day)}$$

for the shallow aquifer.

Values of k, m, i, and L used in calculating the discharge rate from the flow channel shown on Figure 6 were:

$K_{st} = 7.1$ ft/day	$K_{sd} = 8.5$ ft/day
$m_{st} = 5.5$ ft	$m_{sd} = 3.0$ ft
$i = 0.019$	$L = 279$ ft

Substitution of these values into Equation 5 yields

$$Q = 342 \text{ ft}^3\text{/day (2558 gallons/day)}$$

for the deep aquifer.

TABLE 1

SUMMARY OF RECORDED WATER LEVELS
FOR THE SHALLOW AND DEEP AQUIFERS

	Well No.	7/1/80	8/80	5/26/82	6/8/82	8/11/82	10/15/82	11/18/82
Shallow Aquifer	OW-1s	741.6	741.9	741.7	741.0	739.3	738.3	739.1
	OW-2s	743.2	742.9	742.8	742.8	741.8	740.8	741.1
	OW-3s	753.0	752.7	752.6	752.6	750.9	750.2	751.2
	OW-4s	739.7	739.3	740.3	739.1	737.0	735.9	737.3
Deep Aquifer	OW-1d	720.2	720.2	722.0	721.2	720.6	720.4	720.3
	OW-2d	725.8	725.9	727.1	727.1	727.4	725.9	726.6
	OW-3d	726.7	726.5	728.4	728.4	727.2	727.3	727.5
	OW-4d	718.6	718.7	720.1	719.5	718.5	718.6	719.0
	OW-5	715.9	716.4	717.3	717.0	715.4	715.8	716.5

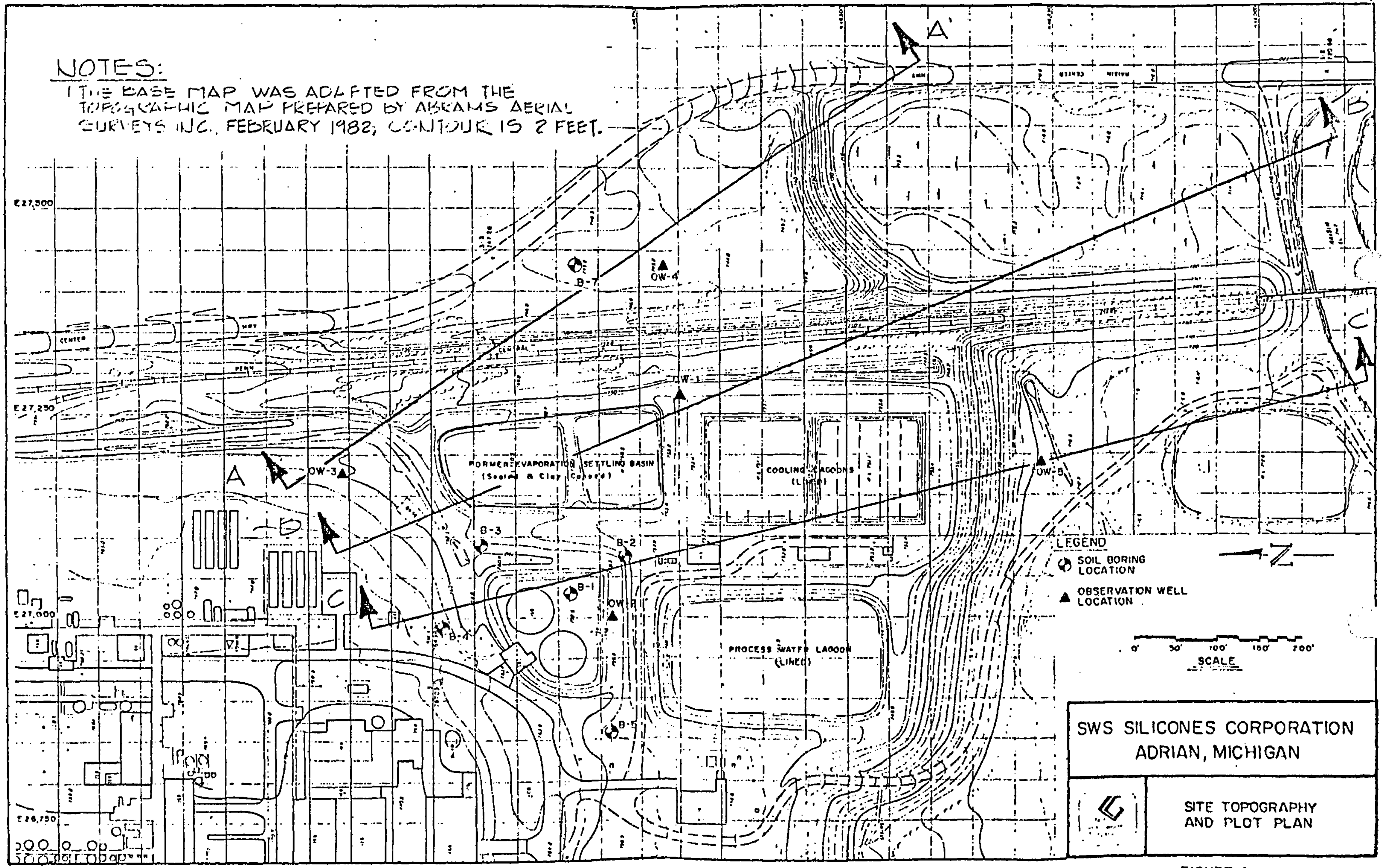
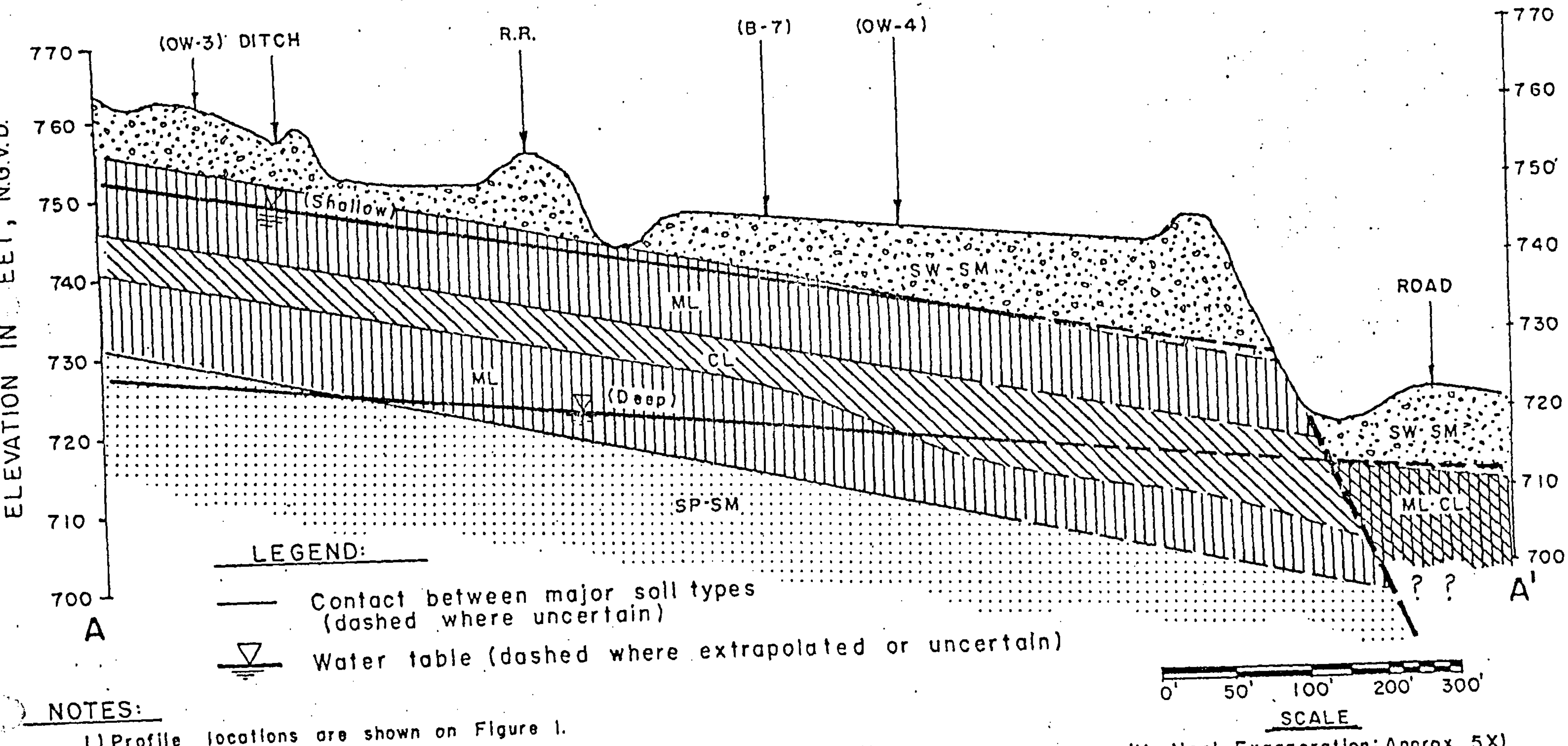

NOTES:
1 THE BASE MAP WAS ADAPTED FROM THE TOPOGRAPHIC MAP PREPARED BY ABRAMS AERIAL SURVEYS INC. FEBRUARY 1982; CONTOUR IS 2 FEET.
A
A'
B
C
C'
B-1
B-2
B-3
B-4
B-5
B-7
OW-1
OW-2
OW-3
OW-4
OW-5
FORMER EVAPORATION SETTLING BASIN
(Sealed & Clay Capped)
COOLING LAGOONS
PROCESS WATER LAGOON
(LINED)
LEGEND
SOIL BORING LOCATION
OBSERVATION WELL LOCATION
0' 50' 100' 150' 200'
SCALE
E27,500
E27,250
E27,000
E26,750
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
SITE TOPOGRAPHY AND PLOT PLAN

FIGURE 1



LEGEND:

Contact between major soil types (dashed where uncertain)

Water table (dashed where extrapolated or uncertain)

NOTES:

1.) Profile locations are shown on Figure 1.

2.) Soil borings projected to the profile line are enclosed in parentheses.

3.) Abbreviations for general soil types shown on the profile are described on Figure 4.

4.) Water table profiles are based upon water levels measured in the shallow and deep wells on October 15, 1982.

SWS SILICONES CORPORATION
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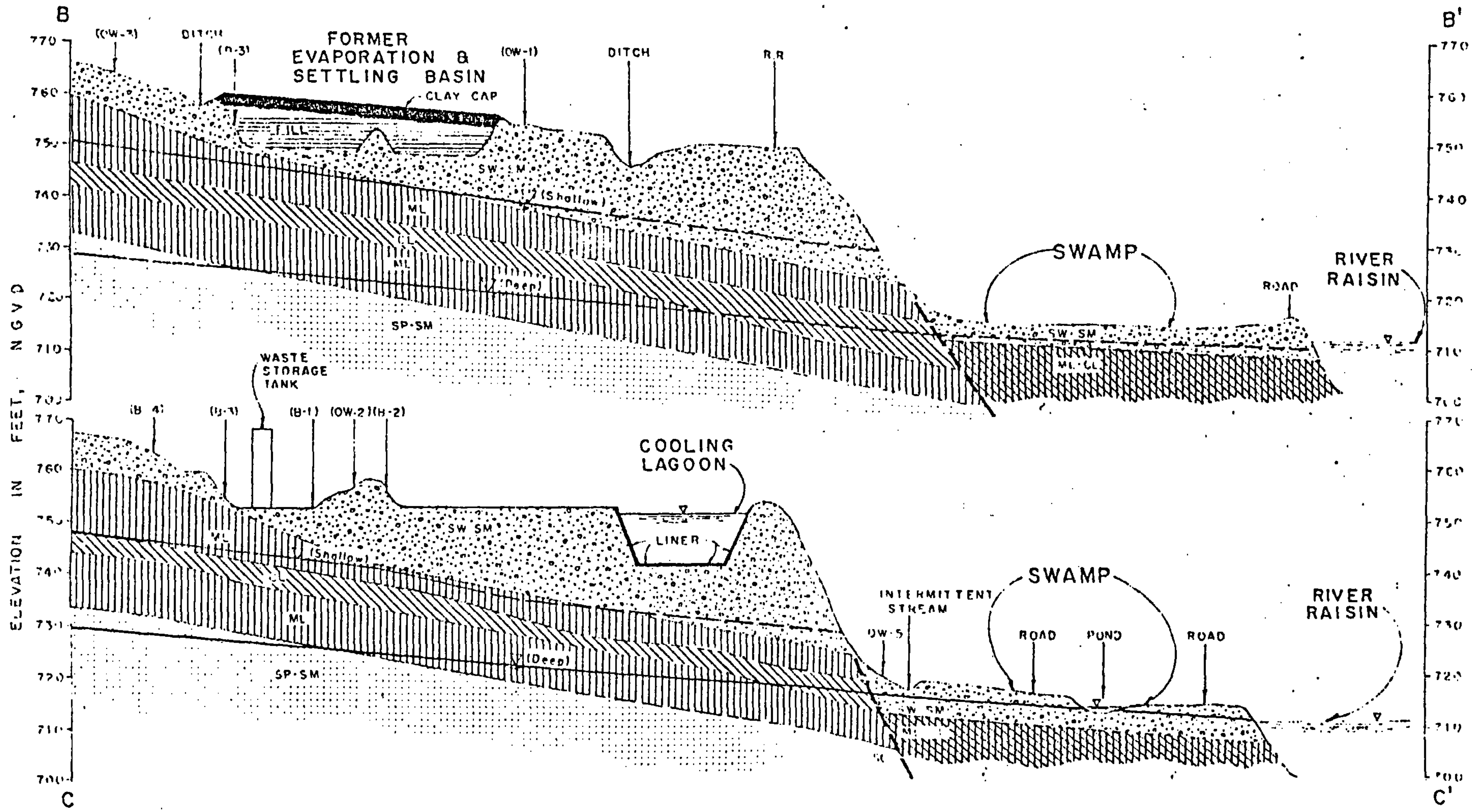
Gilbert Commonwealth Companies

GEOLOGIC PROFILE A-A'



NOTE

1) The legend and notes for these profiles are given on Figure 2.

0' 50' 100' 200' 300'
SCALE
(Vertical Exaggeration: Approx 5X)

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

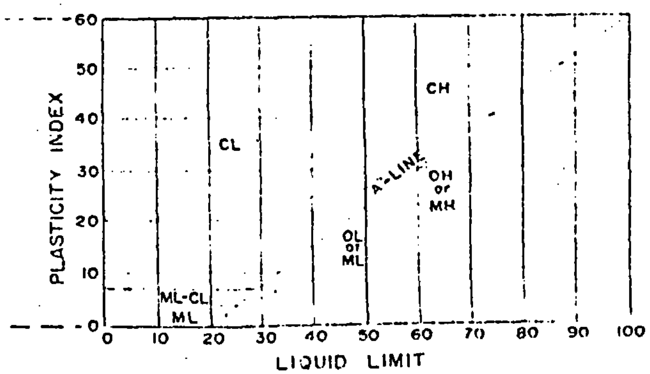
GEOLOGIC PROFILES B-B' AND C-C'

FIGURE 3

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVEL (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE.	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO 200 SIEVE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE.	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND CLAY MIXTURES.
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS.
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

GRAPH SYMBOL	LETTER SYMBOL	ROCK CLASSIFICATION
	SH	SHALE
	SI	SILTSTONE
	SS	SANDSTONE
	LS	LIMESTONE

PLASTICITY CHART



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CLASSIFICATION CHARTS

FIGURE 4

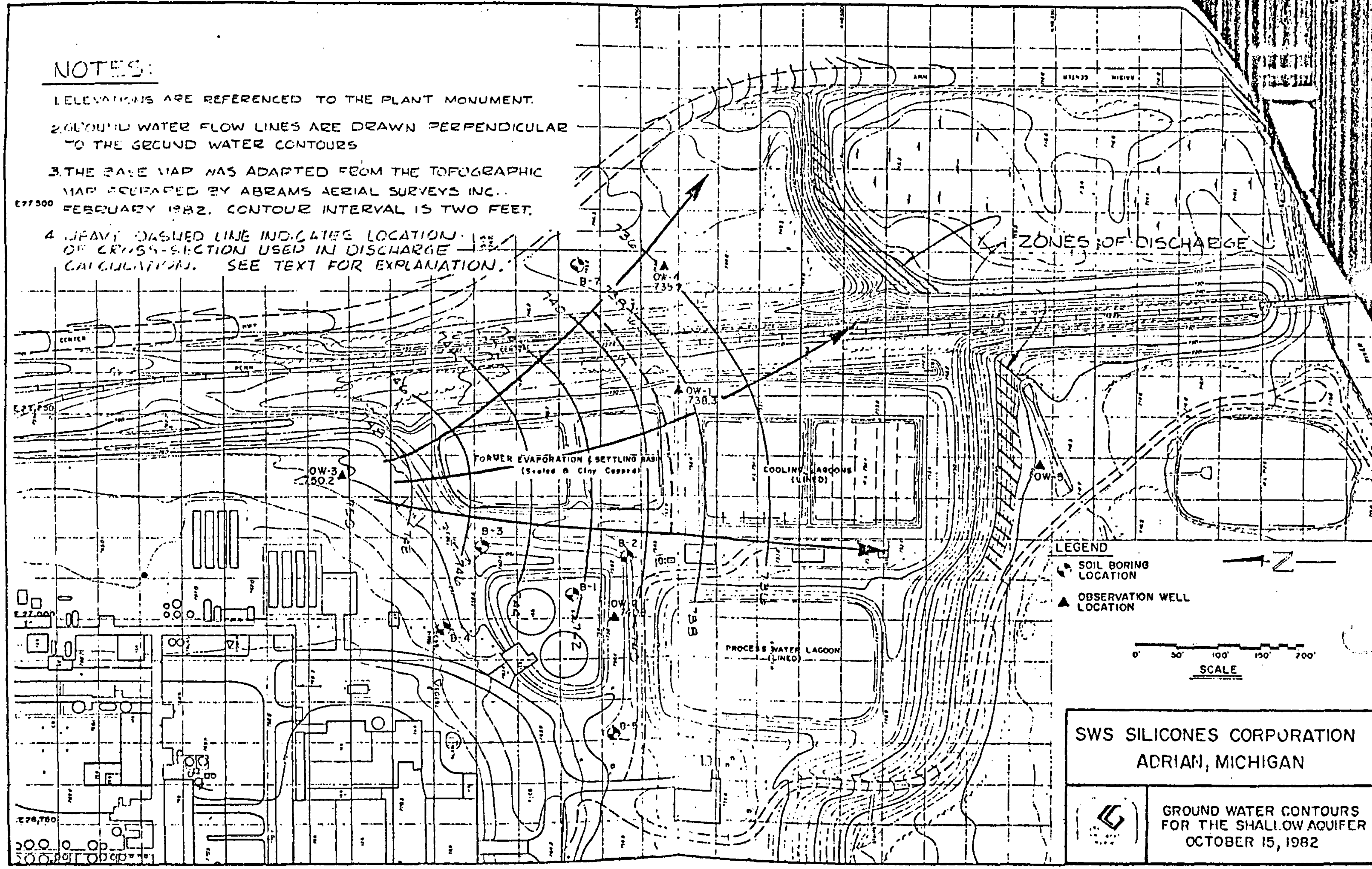
NOTES:
1. ELEVATIONS ARE REFERENCED TO THE PLANT MONUMENT.
2. GROUND WATER FLOW LINES ARE DRAWN PERPENDICULAR TO THE GROUND WATER CONTOURS
3. THE BASE MAP WAS ADAPTED FROM THE TOPOGRAPHIC MAP PREPARED BY ABRAMS AERIAL SURVEYS INC. FEBRUARY 1982. CONTOUR INTERVAL IS TWO FEET.
4. HEAVY DASHED LINE INDICATES LOCATION OF CROSS-SECTION USED IN DISCHARGE CALCULATION. SEE TEXT FOR EXPLANATION.
ZONES OF DISCHARGE
FORMER EVAPORATION & SETTLING BASIN (Sealed & Clay Capped)
COOLING LAGOONS (LINED)
PROCESS WATER LAGOON (LINED)
OW-4 735.9
OW-1 738.3
OW-3 750.2
OW-5
OW-2
B-1
B-2
B-3
B-4
B-5
B-7
LEGEND
SOIL BORING LOCATION
OBSERVATION WELL LOCATION
0' 50' 100' 150' 200'
SCALE
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
GROUND WATER CONTOURS FOR THE SHALLOW AQUIFER
OCTOBER 15, 1982

FIGURE 5

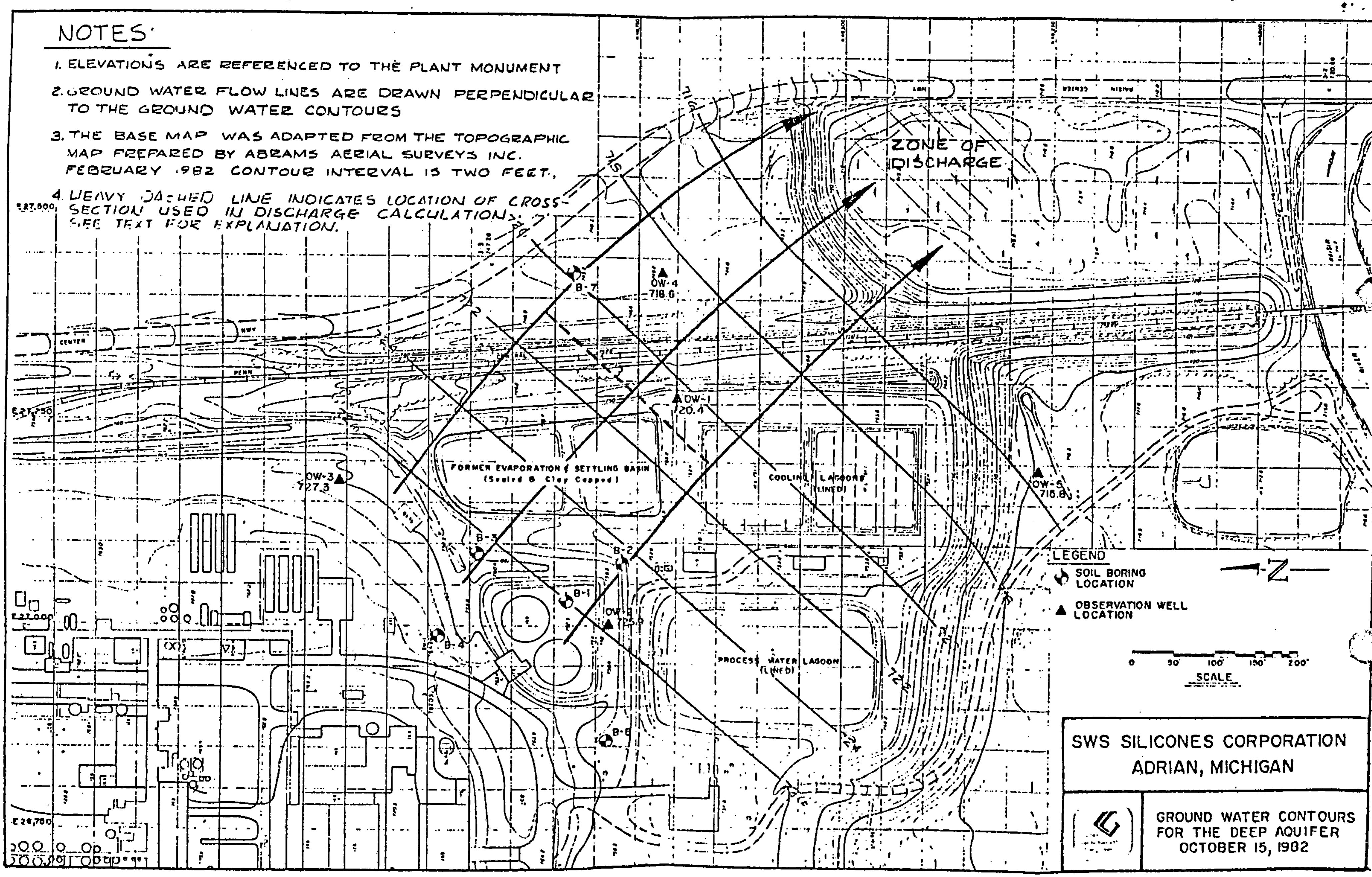
NOTES:
1. ELEVATIONS ARE REFERENCED TO THE PLANT MONUMENT
2. GROUND WATER FLOW LINES ARE DRAWN PERPENDICULAR TO THE GROUND WATER CONTOURS
3. THE BASE MAP WAS ADAPTED FROM THE TOPOGRAPHIC MAP PREPARED BY ABRAMS AERIAL SURVEYS INC. FEBRUARY 1982 CONTOUR INTERVAL IS TWO FEET.
4. HEAVY DASHED LINE INDICATES LOCATION OF CROSS-SECTION USED IN DISCHARGE CALCULATIONS. SEE TEXT FOR EXPLANATION.
ZONE OF DISCHARGE
B-7
OW-4
718.6
OW-1
720.4
OW-3
727.3
FORMER EVAPORATION & SETTLING BASIN
(Sealed & Clay Capped)
COOLING LAGOONS
(LINED)
OW-5
716.8
B-3
B-2
B-1
B-4
OW-2
B-6
PROCESS WATER LAGOON
(LINED)
LEGEND
SOIL BORING LOCATION
OBSERVATION WELL LOCATION
N
0 50' 100' 150' 200'
SCALE
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
GROUND WATER CONTOURS FOR THE DEEP AQUIFER
OCTOBER 15, 1982

FIGURE 6

PERMEABILITY TESTING OF

OW-SERIES OBSERVATION WELLS

FOR

SWS SILICONES CORPORATION

ADRIAN, MICHIGAN

Approved by:

Annette Brewster

Annette Brewster
Senior Geologist/Hydrogeologist
Industrial & Environmental Div.

Prepared by:

Commonwealth Associates Inc.
209 East Washington Avenue
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October 14, 1982

OCT 15 ...

PERMEABILITY TESTING OF OW-SERIES OBSERVATION WELLS FOR SWS SILICONES CORPORATION

INTRODUCTION

Field tests were performed in existing observation wells to obtain permeability estimates for granular soils around the former evaporation basin on the property of SWS Silicones Corporation (SWS), Adrian, Michigan. The tests were conducted on July 27-28, 1982. At the direction of Mr. B. S. McClellan of Stauffer Chemical Company, six of the nine observation wells around the basin were tested: OW-1s, OW-1d, OW-3s, OW-3d, OW-4s, and OW-4d.

Commonwealth Associates Inc. (Commonwealth) installed the OW-series observation wells during June 1980 as part of an investigation to determine the direction of ground water flow in the vicinity of the evaporation basin. Each well was constructed of 2-inch diameter, Schedule 80 PVC casing with 10 feet of slotted PVC screen (Timco). At each location referenced above, a pair of wells was installed and the well screens were set above and below a silty confining layer that begins between depths of 7 and 14 feet below ground. A well installation summary for the entire OW-series is presented in Table 1. Boring logs for OW-1, OW-3, and OW-4 are also attached.

TESTING PROCEDURES

Several factors affected the selection of a permeability testing method for the OW-series wells. Since the wells are used as ground water sampling points, testing methods which removed water from the wells were preferable to those which introduced water from another source. The selection was further limited because water levels in the three deep wells were below the level necessary for suction lift pumping. Static water levels only 5 to 8 feet above the base of the well screen were also marginal for the use of a small diameter submersible pump. Considering these factors, a procedure based upon the measured recovery of water levels following air-lift pumping was selected as an appropriate testing method.

The following procedure was used for the recovery tests. Prior to testing, the depths to water and to the bottom of the well were measured and recorded. Compressed air was then introduced to the bottom of the well to remove the column of standing water. A visible change in the ejection rate was judged to mark the time at which all standing water had been removed. Two Soiltest water level indicators were used to measure water level recovery. The straight line yielded by a plot of the depth to water during recovery versus the logarithum of time since the discharge (air-lift pumping) stopped was used in conjunction with the nonequilibrium formula to compute transmissivity and, from that, permeability.

The recovery procedure proved unsuccessful on wells OW-1d and OW-1s. Prior to testing of OW-1d, the well screen was found to be filled with more than 5 feet of sediment, even though the well had been cleaned out by SWS during the previous week. The level of sediment actually rose more than 1 foot in the well during air-lift pumping. In lieu of a field permeability test, a sample of the sediment blown out during cleaning operations was collected from the ground surface outside of the well casing for particle-size analysis. The permeability of this material was computed from the gradation curve using several accepted empirical equations.

An alternate method of testing well OW-1s had to be found because water levels recovered too quickly to be measured. Water level measurements in this well were also complicated by cascading water in the screened interval. A bailer test was attempted but was only partially successful. However, a record of the bailer volumes removed and the duration of bailing permitted computation of a minimum value for permeability.

CALCULATIONS

Recovery Tests

The governing equation for calculation of permeability from recovery test data is the modified nonequilibrium formula

$$T = \frac{264\ Q}{\Delta s}$$

where T is transmissivity in gallons per day/foot (gpd/ft), Q is the discharge rate in gallons per minute (gpm), and Δs is the change in water level in feet (ft) over one log cycle. However, transmissivity may also be defined as

$$T = km$$

where k is permeability in gpd/ft^2 and m is the saturated thickness in ft. Combination of the two equations yields the relation

$$K = \frac{264\ Q}{m\ \Delta s}$$

The permeability of the formation being tested may be calculated from this relation, with the value of Δs obtained from a plot of water levels measured during recovery versus the logarithum of time since discharge stopped. Permeability calculations are shown on the attached recovery plots for wells OW-3s, OW-3d, OW-4s, and OW-4d. Values of Q and m were determined in the following manner.

The discharge rate used in the computations equals the volume of standing water in the well divided by the duration of air-lift pumping required to remove it. The volume (V) of water in the well was computed from the relation

$$V = \pi (d/2)^2 h$$

where d is the inside diameter of the well screen and casing and h is the height of water in the well. For the wells tested, d = 0.15 ft, which is equivalent to 0.132 gal/ft of water in the well (h). Subtraction of the measured static water level from the measured depth to the bottom of the well provided the value of h. As mentioned earlier, the time required to remove one well volume of water by air-lift pumping was identified by a visible change in the ejection rate. Two assumptions are inherent in the computation of discharge rate by this method: 1) that all water standing in the well was removed during air-lift pumping, and 2) that water from the aquifer did not enter the well during pumping.

Values of m used in the computations were based upon consideration of the static water level and the formations present in the screened interval. It was assumed that all water entering the well during recovery was derived from the coarsest sediments in the screened interval below the water table. For the deep wells, m was assumed to be equal to the height of standing water in the well or the screened thickness of sand below the overlying, silty confining layer, whichever was smaller. For the shallow wells, m was generally assumed to be equal to the screened thickness of saturated sands above the confining layer. In well OW-3s, however, the saturated zone consisted entirely of sandy silt (ML). The approximate thickness and type of soils screened in each well are listed in Table 1.

Permeability calculations for wells OW-3s, OW-3d, OW-4s, and OW-4d are shown on the recovery data plots. Calculated permeability values range from 2.5 X 10^{-3} cm/sec for sandy silt in well OM-3s to 1.7 X 10^{-2} cm/sec for fine to coarse sand in well OM-4s. The value for well OM-4s is the average resulting from two tests. Test results are summarized in Table 2.

Bailer Test

The basis for computing the permeability of granular materials screened in OW-1s is the observation that water entered the well as fast as it was removed by bailing. Knowing the rate at which water entered the well permits the calculation of permeability from Darcy's Law, written as

$$K = \frac{Q}{iA}$$

where K and Q are as previously defined, i is the hydraulic gradient (dimensionless), and A is the surface area of the well screen (ft^2) across which water is flowing.

Prior to bailing, the static water level and depth to bottom of the well were measured at 14.28 ft and 20.00 ft, respectively. During bailing, the time was recorded each time the bailer was removed from the well. A stainless steel bailer having a volume of 0.28 gal was used for the test. Approximately 14 bailer volumes of water were removed. By dividing the total volume of water removed, 3.9 gal, by the total bailing time, 5.82 min, a discharge rate of 0.67 gpm was determined for the test.

For the bailer test, the hydraulic gradient, i, is the change in water level, Δh, divided by the radial distance, R, affected by the withdrawal of water from the well. Based upon the sound of water flowing over the top of the 5-foot long bailer, the apparent height of water in the well during bailing was approximately 5 ft. Taking into account the volume of water displaced by the bailer (0.211 gal), the actual height of water in the well during bailing was approximately 3.4 ft. Therefore, Δh is the actual height of water during bailing subtracted from the original height before bailing (5.7 ft), or 2.3 ft. The radial distance affected by bailing can only be estimated. For a test of such short duration and low discharge rate, R is not likely to exceed 1 foot. Therefore, a hydraulic gradient of 2.3 was used in the permeability calculation.

The area, A, across which water enters the well during recovery may be determined from the equation for surface area of a cylinder

$$A = 2\pi r_w L$$

where r_w is the radius of the well screen (ft) and L is the length of screen (ft) across which flow occurs. For the OW-series wells, r_w equals 0.075 ft. Two cases are considered. If water enters the well through the full length of screen below the static water level, then L is equivalent to the height of water in the well before bailing (h), or 5.7 ft. If, however, water enters the well only from the sandy soil (SW·SM) above the silty confining layer, L is equal to 1.8 ft.

Substitution of the appropriate values of Q, i, and A into the Darcy equation yields permeability values of 7.4×10^{-3} cm/sec for L = 5.7 ft and 2.3×10^{-2} cm/sec for L = 1.8 ft. Because the well was not totally evacuated during bailing, some water stored in the filter sand around the screen also entered the well during the test. Therefore, the actual permeability is probably an intermediate value between the two cases. Assuming a simple average as a first approximation, the permeability of the fine to coarse sand in well OW-1s is approximately 1.5×10^{-2} cm/sec.

Particle-Size Analysis

The permeability of the sandy soils screened in well OW-1d may be estimated from particle-size data taken from the attached gradation curve. Although the analyzed sand sample was obtained from the ground surface outside the well casing, it is believed to be representative of the sediment inside the well screen.

Three empirical methods were used to compute permeability: Hazen's Approximation, the method of Beyer (1969), and the method of Masch and Denny (1966). All three methods are described in Commonwealth Report No. R-2451, "Hydrogeologic Investigation of Disposal Area," for SWS Silicones Corporation. Permeability values calculated from these methods ranged from 2.0×10^{-3} to 7.3×10^{-3} cm/sec, and averaged 3.8×10^{-3} cm/sec.

DISCUSSION

Permeability values for granular soils in the six tested observation wells are listed in Table 2. Limitations on the accuracy of the permeability values reported in Table 2 should be understood before they are used to calculate ground water flow rates. The various assumptions described in the calculations section introduce a degree of uncertainty to each permeability value. Moreover, direct comparison of permeability from one well and soil type to another is complicated because three different methods were used. For example, a recovery test was performed during development of well M-1 in the disposal on June 14, 1982, using the same testing procedure described in this letter report. The resulting permeability was 2.9×10^{-3} cm/sec. Based upon particle-size data for boring M-1 (samples 11 and 12), an average permeability of 4.9×10^{-3} cm/sec was calculated. Thus, it appears that permeability values computed from particle-size data are higher than those from recovery test data. If a recovery test could have been performed in well OW-1d instead of a particle-size analysis, the reported permeability value would probably be lower than 3.8×10^{-3} cm/sec (Table 2). Unfortunately, a similar comparison between bailer test results and the other test methods cannot be made since the bailer test was performed in only one well.

In general, the permeability of the upper sand layer is higher than that of the sand below the confining layer. This result was expected because the OW-series borings indicated the presence of coarser soils above the confining layer. For the purposes of future computations, we recommend using a

56.7 ft/day permeability value of 2×10^{-2} cm/sec for the upper fine to

.5ft/day coarse sand layer and 3×10^{-3} cm/sec for the lower silty sand layer. These values reflect the relative permeability difference between the upper and lower sand layers and are considered accurate to within one-half an order of magnitude.

TABLE I

Old Evaporation Pond, Well Analyses

For June 9, July 21 and August 11, 1982

mg/l

Well #	T.O.C. 6/9	T.O.C. 7/21	T.O.C. 8/11	Chloride 6/9	Chloride 7/21	Chloride 8/11	di-n-butyl-phthalate 6/9
1S	30	900	1000	950	1600	2157	≤ 0.025
1D	13	100	(1)	855	1180	(1)	ND(2)
2S	29	28	24	440	410	547	ND(2)
2D	5	(1)	(1)	240	(1)	(1)	≤ 0.030
3S	14	13	14	190	400	537	ND(2)
3D	5	7	6	174	250	239	≤ 0.025
4S	20	34	360	1280	1390	1978	ND(2)
4D	8	8	11	273	235	249	ND(2)
5	14	16	18	370	370	403	ND(2)

Well #	1,1,1 trichloroethane 6/9	1,1,1 trichloroethane 7/21	1,1,1 trichloroethane 8/11	t-1,2-dichloroethylene 6/9	t-1,2-dichloroethylene 7/21	t-1,2-dichloroethylene 8/11	1,1 dichloroethane 6/9	1,1 dichloroethane 7/21	1,1 dichloroethane 8/11
1S	3.7	5.5	6.9	ND	ND	ND(3)	17	28	36
1D	0.13	0.12	(1)	ND	ND	(1)	ND	ND	(1)
2S	0.25	0.40	0.61	0.74	0.65	0.67	ND	ND	0.01
2D	ND	(1)	(1)	ND	(1)	(1)	ND	(1)	(1)
3S	0.30	1.0	1.7	ND	ND	0.01	ND	ND	0.01
3D	ND	ND	ND	ND	ND	ND	ND	ND	ND
4S	3	2.5	3.6	0.80	0.03	0.03	ND	0.40	0.35
4D	0.08	0.06	0.18	0.04	0.05	0.16	ND	ND	ND
5	0.25	0.20	0.31	0.14	0.25	0.40	ND	ND	ND

(1) Insufficient water for sampling.

(2) Detection limit about 0.02 mg/l.

(3) Detection limit about 1.0 mg/l in this sample.

(4) Other ND (None Detected) limits about 0.01 mg/l.

G. C. Philbrook
12-22-82

INSTALLATION SUMMARY FOR
OW-SERIES OBSERVATION WELLS
TABLE 1

Well No.	Date Installed	Surveyed Elevation Top of PVC ft	Measured PVC Height Above Ground ft	Ground Elevation ft	Screened Interval Depth ft / Elevation ft	Elevation, Top of Sand Filter ft	Elevation, Top of Bentonite ft	Approx. Thickness of Screened Formation ft
OW-1d	6/20/80	752.77	0.8	752.0	30.8-40.8/712.0-722.0	724.5	727.5	7'ML/3'SP·SM
OW-1s	6/20/80	754.08	1.3	752.8	10.6-20.6/733.5-743.5	747.8	749.8	5.5'SW·SM/4.5'ML
OW-2d	6/23/80	755.91	2.1	753.8	27.6-37.6/718.3-728.3	731.8	734.8	3.5'ML/6.5'SM
OW-2d	-	761.91	3.1	758.8	33.6-43.6/718.3-728.3	731.8	734.8	
OW-2s	6/24/80	757.22	3.2	754.0	12.7-22.7/734.5-744.5	747.0	750.0	2.5'SM/7'ML/0.5'CL
OW-2s	-	761.83	3.9	757.9	17.3-27.3/734.5-744.5	747.0	750.0	
OW-3d	6/25/80	763.49	2.8	760.7	32.8-42.8/720.7-730.7	738.7	741.7	2'ML/8'SM
OW-3s	6/25/80	764.23	3.3	760.9	10.3-20.3/743.9-753.9	754.9	757.9	10'ML
OW-4d	6/26/80	748.51	3.6	744.9	30.6-40.6/707.9-717.9	720.9	723.9	8'ML/2'SM
OW-4s	6/27/80	748.09	2.9	745.2	6.4-16.4/731.7-741.7	742.2	744.2	6.5'SW/3.5'ML
OW-5	6/24/80	722.77	3.2	719.6	8.2-18.2/704.6-714.6	715.6	717.1	2'SW/4.5'ML·CL/ 3.5'SC

Notes:

1. All depths are below top of PVC casing.

2. During dike construction, the top of wells OW-2d and OW-2s was raised by adding 6.0 and 4.6 feet of PVC casing to the wells, respectively. Top of PVC elevations were not resurveyed.

RESULTS OF PERMEABILITY TESTS
CONDUCTED JULY 27-28, 1982

TABLE 2

Well No.	Test Type	Permeability, cm/sec	Soil Description (1)
OW-1s	Bailer	1.5×10^{-2}	Fine-coarse sand
OW-1d	Particle-size	3.8×10^{-3} (2)	Silty fine sand
OW-3s	Recovery	2.5×10^{-3}	Sandy silt
OW-3d	Recovery	2.8×10^{-3}	Silty fine sand
OW-4s	Recovery	1.7×10^{-2} (3)	Fine-coarse sand
OW-4d	Recovery	3.8×10^{-3}	Silty fine sand

Notes:

(1) Coarsest saturated soils within screened interval.

(2) Average of three values.

(3) Average of two values.

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-1

SURFACE ELEVATION 752.1
COORDINATE 1298 S − 3612E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
										5	10	⊠	SM	Brown fine to medium SAND, some silt. (Fill) (Medium Dense)
									8.6	10	15	⊠	SW SM	Varicolored fine to coarse SAND and fine gravel, trace silt.
										15	36	⊠	ML	Light gray-brown SILT, some fine sand. (Medium Dense)
									87.2		23	⊠		
										20	46	⊠		Grades to gray, thin clay seams noted.
											17	⊠		
			28.4	11.6	22.4				90.1	25	16	⊠	CL	Gray CLAY, trace silt, coarse sand noted. (Stiff)
											15	⊠		
									68.8	30	49	⊠	ML	Gray SILT, some fine sand. (Very Dense)
											58	⊠		
										35				
									6.4	40	64	⊠	SP SM	Brown fine SAND, trace silt. (Very Dense)
										45				
										50				
										55				
										60				

Boring terminated at 40' on 6/20/80. Water level encountered at 10.8' and 31.4'

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 40.0 feet; gravel packed to a depth of 27.5 feet; bentonite seal from a depth of 24.5 to 27.5 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 19.3 feet; gravel packed to a depth of 5.0 feet; bentonite seal from a depth of 3.0 to 5.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ▣ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- ☐ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC ST[illegible]Y
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-3

SURFACE ELEVATION 760.7
COORDINATE 897S - 3512E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD		DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
									38.6	5	9	⊠	SM	Brown fine to coarse SAND and SILT. (Fill) (Loose)
										10	10	⊠	ML	Brown SILT, some fine sand.
									74.7	15	32	⊠		Grades to gray. (Graded Dense)
		PN-2750	30.4	13.0	19.2					20	17	⊠	CL	Gray CLAY. (Stiff) Grades with silt seams.
		PN-3700									29	⊠		Grades with silt seams.
									71.2	25	72	⊠	ML	Gray SILT, some fine sand. (Very Dense)
										30	37	⊠		(Grades Dense) Grades to tan.
										35	60	⊠	SM	Brown fine SAND, trace silt. (Very Dense)
										40	78	⊠		Boring terminated at 40.5' on 6/25/80. Water level encountered at 7.7' and 33.7'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 40.0 feet; gravel packed to a depth of 22.0 feet; bentonite seal from a depth of 19.0 to 22.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 17.0 feet; gravel packed to a depth of 6.0 feet; bentonite seal from a depth of 3.0 to 6.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-4

SURFACE ELEVATION 744.9'
COORDINATE 1276 S-3762E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD		DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
													SW	Brown fine to coarse SAND. (Medium Dense)
									2.4	5	12	⊠		
										10	27	⊠		
													ML	Tan SILT, trace fine sand. (Medium Dense)
									99.0	15	18	⊠		
											21	⊠		Grades to gray.
										20	12	⊠	CL	Gray CLAY. (Stiff)
		PN-2250	31.6	11.7	23.0						14	⊠		
										25	13	⊠		
									61.6	30	47	⊠	ML	Gray SILT, some fine sand. (Dense)
										35	69	⊠		
													SM	Gray fine SAND, trace silt. (Very Dense)
									6.7	40	62	⊠		Boring terminated at 40' on 6/26/80 Water level encountered at 4.5' and 28.0'
										45				
										50				
										55				
										60				

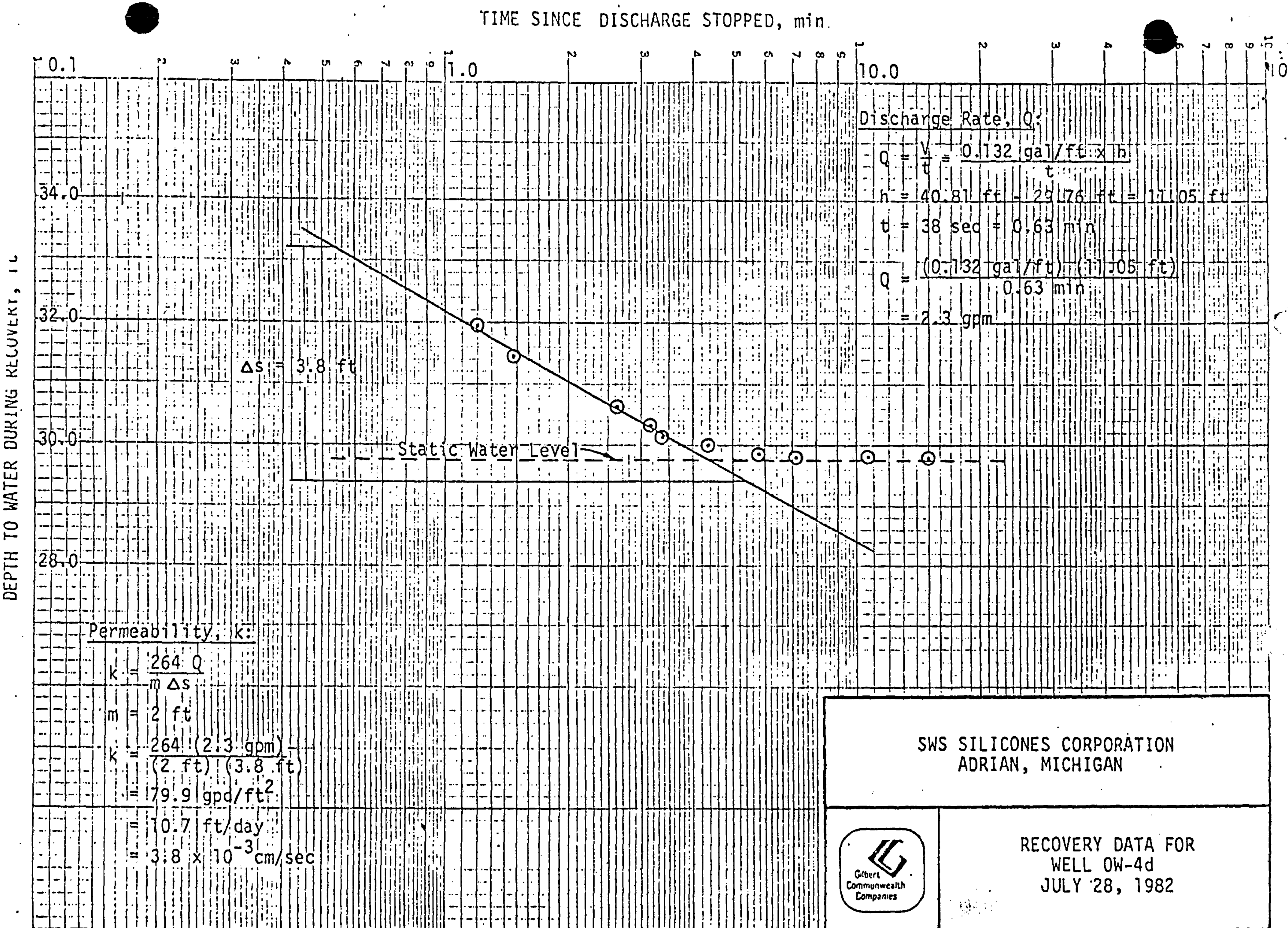
Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 37.0 feet; gravel packed to a depth of 24.0 feet; bentonite seal from a depth of 21.0 to 24.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 13.5 feet; gravel packed to a depth of 3.0 feet; bentonite seal from a depth of 1.0 to 3.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

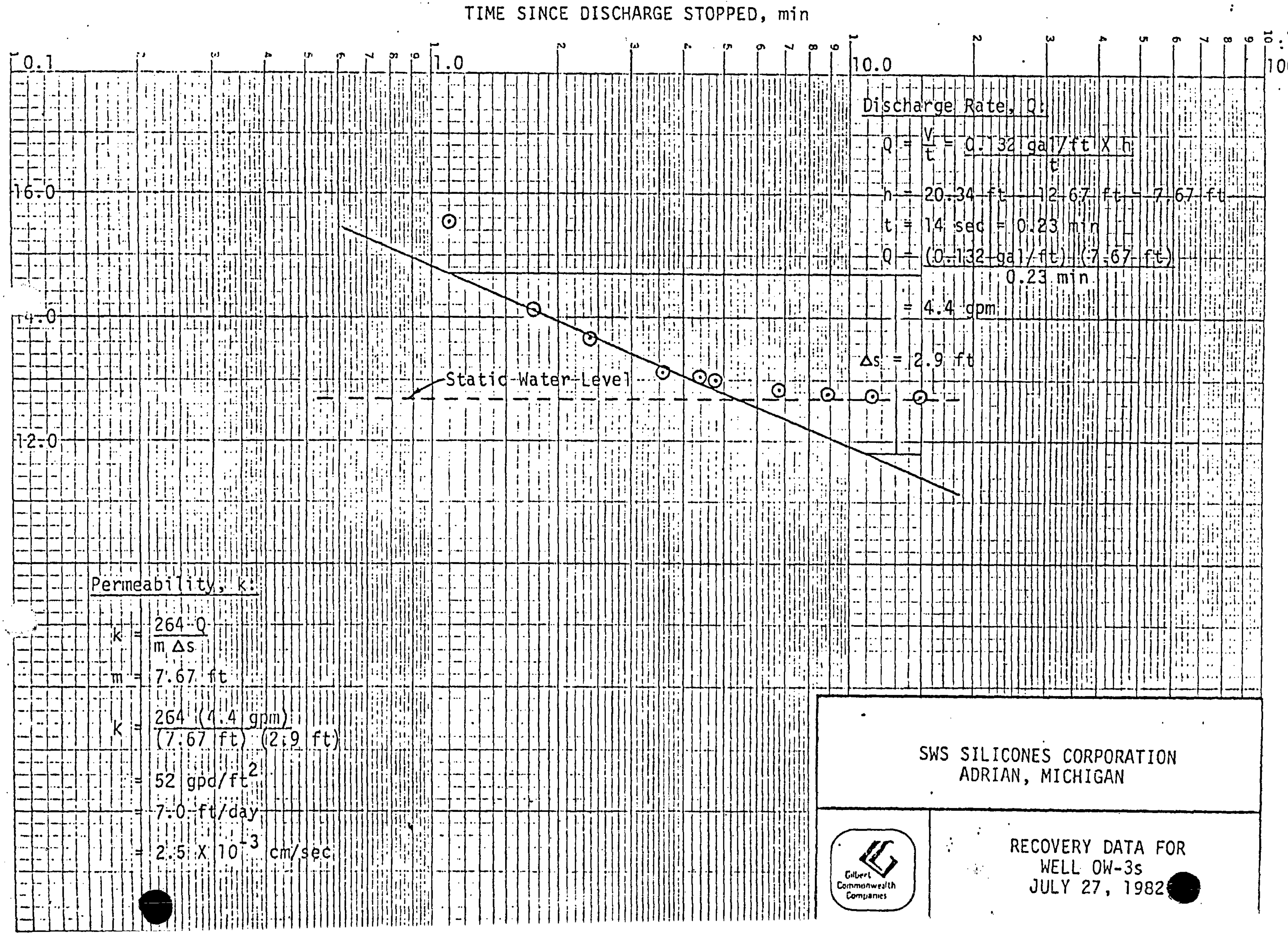
LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ▩ — UNDISTURBED SOIL SAMPLE
- ◩ — DISTURBED SOIL SAMPLE
- ☐ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth


TIME SINCE DISCHARGE STOPPED, min.
0.1
1.0
10.0
100
DEPTH TO WATER DURING RECOVERY, ft
34.0
32.0
30.0
28.0
Δs = 3.8 ft
Static Water Level
Discharge Rate, Q:
Q = V/t = 0.132 gal/ft x h / t
h = 40.81 ft - 29.76 ft = 11.05 ft
t = 38 sec = 0.63 min
Q = (0.132 gal/ft) (11.05 ft) / 0.63 min
= 2.3 gpm
Permeability, k:
k = 264 Q / m Δs
m = 2 ft
k = 264 (2.3 gpm) / (2 ft) (3.8 ft)
= 79.9 gpd/ft2
= 10.7 ft/day
= 3.8 x 10-3 cm/sec
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
Gilbert Commonwealth Companies
RECOVERY DATA FOR
WELL OW-4d
JULY 28, 1982



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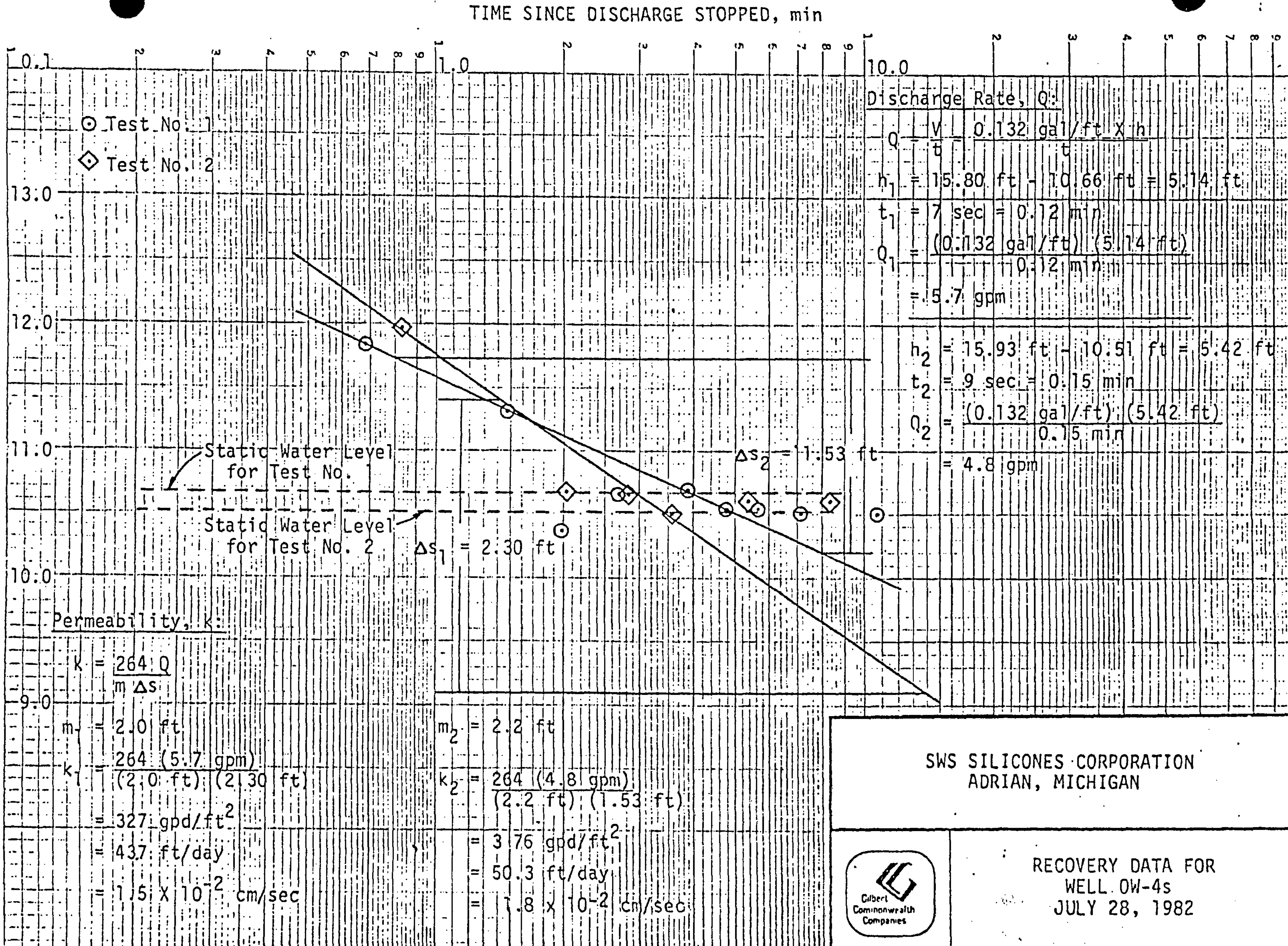
RECOVERY DATA FOR
WELL OW-3s
JULY 27, 1982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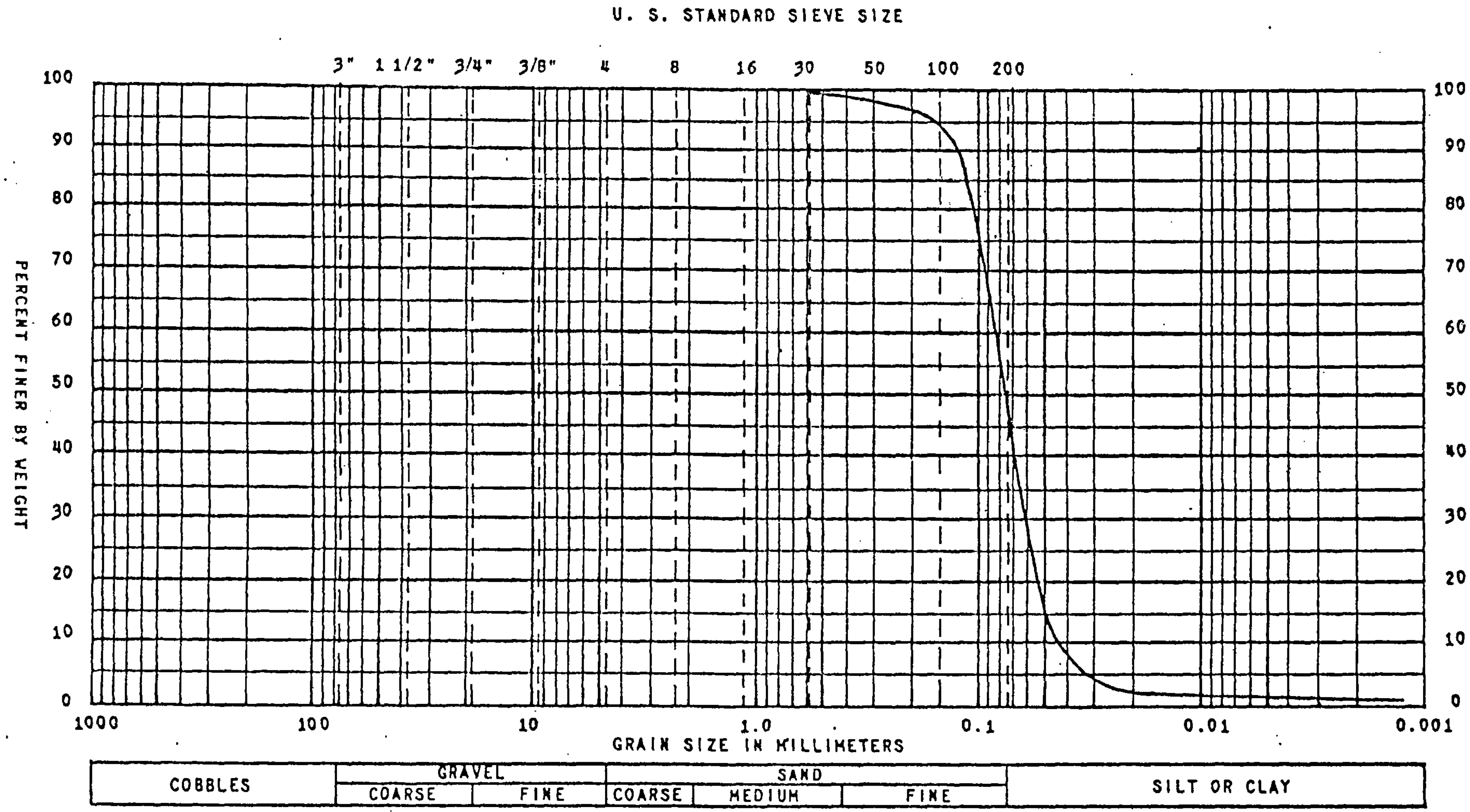
0.1
1.0
10.0
100
13.0
12.0
11.0
10.0
9.0
Test No. 1
Test No. 2
Static Water Level for Test No. 1
Static Water Level for Test No. 2
Δs2 = 1.53 ft
Δs1 = 2.30 ft
Discharge Rate, Q:
Q = V/t = 0.132 gal/ft X h / t
h1 = 15.80 ft - 10.66 ft = 5.14 ft
t1 = 7 sec = 0.12 min
Q1 = (0.132 gal/ft) (5.14 ft) / 0.12 min
= 5.7 gpm
h2 = 15.93 ft - 10.51 ft = 5.42 ft
t2 = 9 sec = 0.15 min
Q2 = (0.132 gal/ft) (5.42 ft) / 0.15 min
= 4.8 gpm
Permeability, k:
k = 264 Q / m Δs
m1 = 2.0 ft
k1 = 264 (5.7 gpm) / (2.0 ft) (2.30 ft)
= 327 gpd/ft2
= 43.7 ft/day
= 1.5 X 10-2 cm/sec
m2 = 2.2 ft
k2 = 264 (4.8 gpm) / (2.2 ft) (1.53 ft)
= 376 gpd/ft2
= 50.3 ft/day
= 1.8 X 10-2 cm/sec
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
Gilbert Commonwealth Companies
RECOVERY DATA FOR
WELL OW-4s
JULY 28, 1982



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
OW-1d	*	SM	SILTY SAND					

* Sand from screened interval.

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

GRADATION CURVE
FROM WELL OW-1d

HYDROGEOLOGIC INVESTIGATION
OF DISPOSAL AREA

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

R-2451

Approved by:

Prepared by:

Commonwealth Associates Inc.
209 East Washington Avenue
Jackson, Michigan 49201
August, 1982

Annette Brewster
Annette Brewster
Senior Geologist/Hydrogeologist
Industrial & Environmental Div.

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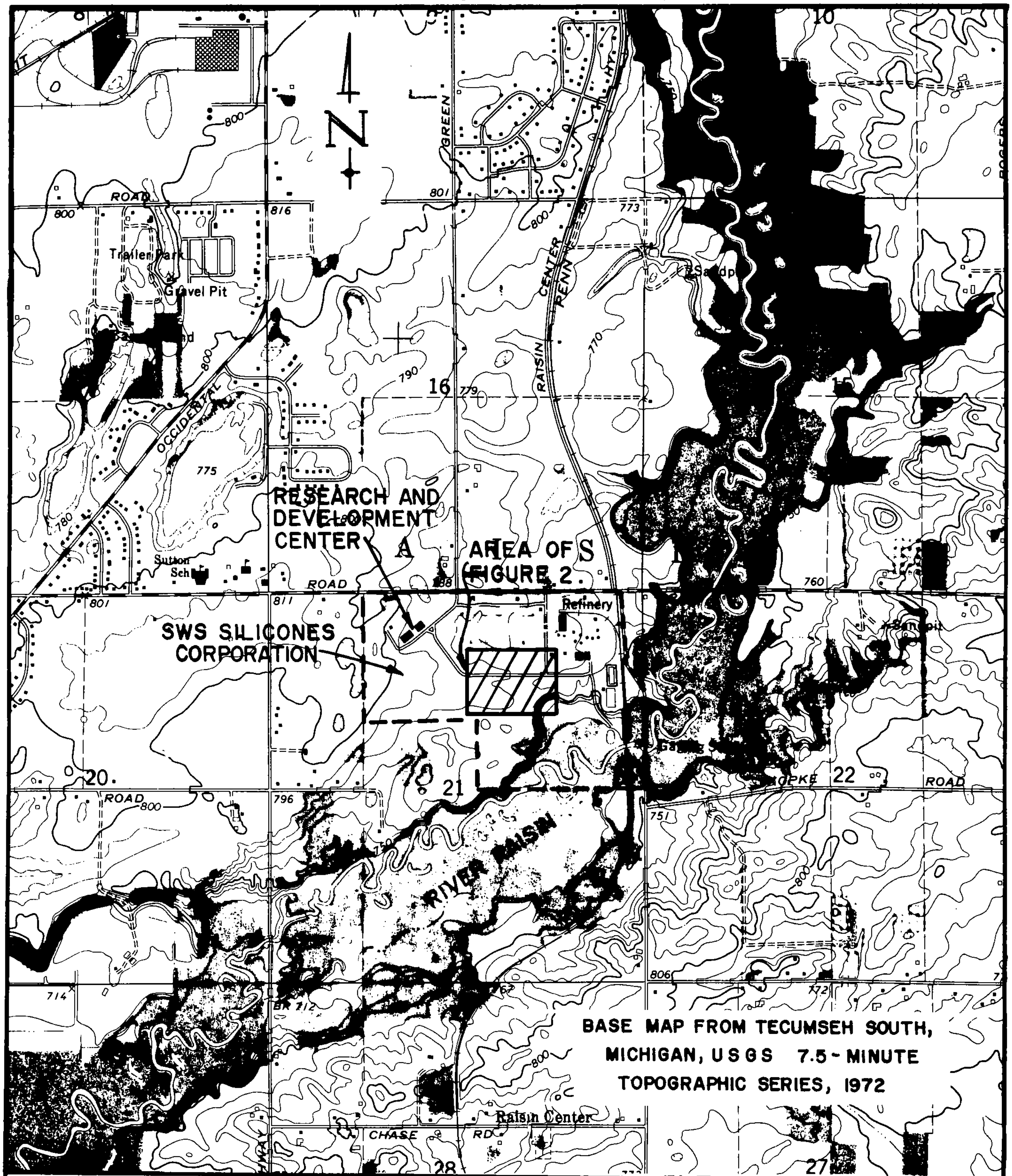
I. PURPOSE AND LOCATION OF INVESTIGATION

In June 1982, Commonwealth Associates Inc. (Commonwealth) was retained by Stauffer Chemical Company to establish the existing hydrogeologic conditions in the vicinity of a disposal area on the property of SWS Silicones Corporation (SWS). The scope of the investigation was limited to definition of the physical parameters governing the occurrence and movement of ground water in the disposal area, particularly the nature of shallow subsurface materials and hydraulic gradient.

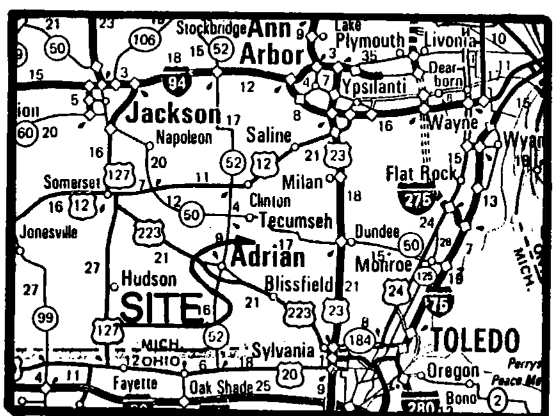
Located in the west half of the northeast quarter of Section 21 in Raisin Township (T.6S, R.4E), Lenawee County, the study area is approximately 4 miles south of Tecumseh and 4 miles northeast of Adrian, Michigan (Figure 1). The disposal area is approximately 1,200 feet south of Sutton Road, near the center of the SWS site. As shown on Figure 2, the valley of the River Raisin approaches to within 300 feet of the disposal area.

Wastes from the SWS plant were previously disposed within the area shown on Figure 2. The outer limits of the disposal area, which encompasses approximately 4 acres, were previously identified by SWS officials. In September 1972, approximately 100 steel drums containing mixed silanes were buried about 6 feet below grade within a small portion of the disposal area. The remainder of the disposal area contains scattered deposits of fine slag resulting from plant operations. Some plant refuse may also be buried within the area according to SWS officials.

T6S



R
4
E



SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

GENERAL SITE LOCATION

FIGURE 1

II. SUMMARY

Four test borings were drilled on the property of SWS Silicones Corporation to determine the hydrogeologic conditions around a 4-acre disposal area. The 40-foot borings encountered two distinct layers of sand: an upper layer of fine to coarse sand and a lower layer of fine sand with varying amounts of silt. Two borings on the south and east sides of the disposal area, M-3 and M-4, also encountered approximately 10 feet of interbedded silt, clayey or sandy silt, and silty clay between the sand layers. The top of the interbedded material begins approximately 6.5 feet below existing grade. Owing to relatively high clay contents, the interbedded sediments could function as a barrier to vertical infiltration if they are areally extensive. Dry soils above these materials and the variability of soils exhibited in the 1964 exploration borings strongly suggest they are not continuous beneath the SWS site.

A PVC monitoring well was installed in each test boring in order to measure ground water levels and to permit sampling of ground water quality. One well, M-4, is located directly downgradient of the drum disposal area. The wells are screened approximately 3 feet below the water table in the lower fine sand aquifer. Ground water levels measured on June 17, 1982, ranged from elevation 749.53 feet on the northwest of the waste disposal area to 737.89 feet on the southeast. Based upon a ground water contour map and a permeability of 6×10^{-3} cm/sec estimated from grain size data, ground water beneath the disposal area is flowing to the southeast toward the River Raisin valley at an approximate rate of 2 feet/day. The average hydraulic gradient is 0.019.

III. METHODS OF INVESTIGATION

Review of Existing Data

Published literature and reports of previous onsite investigations by Commonwealth and by others were reviewed to establish the hydrogeologic setting of the study area. Published data for the area are limited to the Tecumseh South Topographic Quadrangle, 7.5-minute series (USGS, 1972), and the report "Southeastern Michigan Water-Resources Study" by F. W. Twenter (1975). Onsite data included:

1. Logs of 38 shallow exploration borings drilled to depths of 15 to 40 feet in 1964 prior to plant construction.

2. Logs of 11 water supply test wells drilled in the middle 1960's, 1979, and 1980.

3. Logs of 12 soil borings drilled to depths of 12 to 40 feet in 1980 for waste storage tanks and the evaporation and settling basin.

4. Logs of two test wells for water supply drilled in 1980.

None of the above borings or test wells were located within the disposal area.

Soil Borings

Four soil borings, M-1 through M-4, were drilled in the study area between June 8 and June 10, 1982. Boring locations are shown on Figure 2. The borings were approximately 40 feet deep and were drilled using truck-mounted rotary drilling equipment. Soil samples were taken at 2.5- to 5.0-foot intervals using a split spoon sampler (Standard Penetration Test). Drilling operations were supervised by a Commonwealth geologist who maintained a continuous log of the soils encountered. Soils were classified in accordance with the Unified Classification System (Figures 3 and 4). Logs of the borings are presented in Figures 5 through 8.

The first boring drilled, M-1, was advanced using 6-inch hollow stem augers. However, heaving sand below the water table, which could not be controlled with either clear water or thin bentonite drilling mud, dictated a change in drilling method. In the remaining borings, 3-inch solid stem or flight augers were used to advance the borehole to the water table. Drilling continued below the water table with rotary wash bits while a thin bentonite slurry was circulated to keep the borehole open. Water used during drilling was obtained from the plant potable water system.

Cross-contamination between boreholes was minimized using several techniques. Boring M-1, located upgradient of the disposal area, was drilled first. The downgradient borings were drilled in the probable order of increasing contamination potential based upon the likely direction of ground water flow inferred from the surface topography. All drilling equipment, including the rig, was flushed with potable water prior to moving to the next boring location. In addition to these precautions, a new batch of bentonite slurry was prepared for each boring. The spent slurry was incorporated into the grout used to seal the borehole.

Laboratory Soils Tests

Soil samples collected during drilling were taken to Commonwealth's soils laboratory in Jackson for review and testing. Selected samples were subjected to laboratory tests to determine particle size and Atterberg limits. Particle-size tests included sieve and hydrometer analyses. Analytical results were used to refine the soils classification assigned in the field during drilling. Laboratory test results are summarized on each boring log.

Gradation curves for all tested are presented on Figures 9 and 10. Data from these curves were used in conjunction with accepted equations to estimate the hydraulic conductivity (permeability) of the more granular soils. Permeability estimates are discussed in Section V.

Monitoring Wells

A 2-inch diameter observation well was constructed in each borehole upon completion of drilling to permit the measurement of ground water levels. The wells were also designed to be suitable as monitoring wells for ground water quality. A well installation summary is presented in Table 1.

Each well is constructed of threaded, flush-joint PVC casing attached to 5 feet of Johnson, continuous-slot PVC well screen having a slot size of 0.006 inch. All screens and casing sections were steam cleaned, wrapped in plastic, and heat sealed by the manufacturer. Materials required for well construction were unwrapped immediately prior to installation.

In borings M-2 through M-4, the casing-screen assembly was installed in a slurry-filled borehole such that the top of the screen was approximately 3 feet below the water table noted

TABLE 1

WELL INSTALLATION SUMMARY

Well No.	Date Installed	Location Plant Coordinates	Elev., Top of PVC ft, NGVD	PVC Height Above Ground ft	Ground Elev. ft, NGVD	Screened Interval Depth* /Elevation ft / ft, NGVD	Elev., Top of Sand Filter ft, NGVD	Elev., Top of Bentonite Seal ft, NGVD
M-1	6/08/82	N 48,826 E 25,337	783.28	2.8	780.5	34.5-38.5/742.0-746.0	747.5	749.5
M-2	6/09/82	N 48,483 E 25,572	777.79	2.8	775.0	35.4-40.4/734.6-739.6	743.8	746.2
M-3	6/09/82	N 48,647 E 25,998	773.41	2.5	770.9	34.4-39.4/731.5-736.5	739.9	742.9
M-4	6/10/82	N 48,556 E 25,827	773.74	2.3	771.4	35.2-40.2/731.2-736.2	745.6	746.6

*Below ground

Note:

1. During development of well M-1, the bottom plug separated from the well screen, allowing formation sand to enter the well. After flushing with clear water, pea gravel was added to a height of 6 inches above the base of the screen. The well was then sealed with 6 inches of cement, which was allowed to cure for 3 days before the well was redeveloped. Total reduction in screen length by this procedure was 1 foot, leaving 4 feet open to the aquifer.

during drilling. After installation, the borehole was flushed with potable water to remove the drilling fluid. The annular space around and a few feet above the screen was filled with clean silica sand. Flushing in M-2 caused the borehole to collapse around the well screen before the silica sand could be placed. Silica sand was added to raise the sand to the level shown in Table 1 prior to sealing the well. A layer of bentonite pellets followed by bentonite-cement grout was used to fill the remainder of the annular space to the ground surface. Each well was provided with a vented PVC cap and a 4-inch diameter protective steel standpipe.

The installation procedure for well M-1 differed slightly from that employed for the other wells. After the casing-screen assembly was placed in M-1, the hollow stem augers were pulled back to the top of the screen. Before the filter (silica) sand could be placed, however, the borehole collapsed around the screen so that fine sand formation material (SP-SM) is in direct contact with the screen. Prior to sealing,filter (silica) sand was added to raise the sand to the level shown in Table 1.

One objective of this investigation was to install a monitoring well directly downgradient of the drum disposal area. To do this, a sequential installation procedure was employed wherein the first three wells were installed to establish the direction of ground water flow. The location of boring and monitoring well M-4 was then selected based upon a flow map drawn using water levels observed during drilling and measured upon completion of wells M-1, M-2, and M-3.

Because the water level in the observation wells was below the limits for suction-lift pumping, the wells were developed with compressed air. The grout was allowed to set at least 12 hours before development began. Each well was developed until water bailed from the well was clear and sand free. Development time ranged from approximately 1.5 hours for M-3 to 4 hours for M-1.

Upon completion, observation well locations and elevations were established by registered surveyors from Commonwealth from the plant monument and grid system shown on Figure 2. The measuring point elevations recorded in Table 1 are for the highest point on the PVC casing with the PVC cap removed. Measured depths to water in the wells were converted to elevations in order to determine the direction of ground water flow and magnitude of the hydraulic gradient. All depths to water were measured using an electric water level indicator.

IV. HYDROGEOLOGIC SETTING

The study area is situated on rolling uplands adjacent to the valley of the River Raisin. The ground surface slopes gently to the southeast from a topographic high of approximately elevation 790 feet near the Research and Development Center to below elevation 730 feet in the floodplain of the river. The center of the waste disposal area is approximately 1,500 feet southeast of the Research and Development Center and 500 feet northwest of the closest approach of the floodplain (Figures 1 and 2). Topographic relief across the upland is approximately 15 feet. An abrupt change in slope marks the edge of the upland.

The topography of the study area has been altered slightly by disposal and construction activities. Surficial deposits were removed from the southeastern part of the study area for the construction of dikes in another part of the SWS site. Vegetation is sparse in this area because no topsoil is present and medium to coarse sand is exposed at the ground surface.

Soils in the study area consist of interbedded sands, silts, and clays of glacial origin. Based upon logs of the deeper test wells, soils on the upland are more than 200 feet thick. According to Twenter (1975, p. 26), the upper soils were reworked several times and deposited as beaches and lacustrine sediments in a large lake in front of the receding ice. Repeated advances and retreats of the ice front produced a highly variable hydrogeologic environment. The upper soils on the upland are predominantly fine sands with varying amounts of silt. However, logs of the earliest site borings, some of which were drilled 200 feet apart, indicate the presence of discontinuous layers or pockets of sandy silt, clayey silt, silt, and silty clay. In previous investigations, saturated soils were observed beneath a water table in fine sand at depths of 30 to 35 feet below ground.

V. RESULTS OF INVESTIGATION

Stratigraphic Sequence

Logs of the four borings drilled for this investigation are shown on Figures 5 through 9. As expected from previous investigations, sands are the predominant soil type. The uppermost soil beneath 0 to 2 feet of topsoil consists of clean, medium dense, fine to coarse sand with a trace of fine gravel (SP). In the western part of the study area, this material is underlain by dense to very dense cross-bedded, fine sand with varying amounts of silt (SP-SM). Gradation differences between the two types of sand are illustrated on Figure 9. The fine sand in borings M-1 and M-2 began at a depth of approximately 17 feet and continued to the bottom of the borehole. No cohesive material that could function as a confining layer was encountered in these boreholes.

In the eastern part of the study area, approximately 10 feet of interbedded silt, clayey or sandy silt, and silty clay underlain by 1.5 to 5 feet of sandy silt occurs between the upper sand (SP) and lower sand (SP-SM). The top of the interbedded sediments is approximately 6.5 feet below existing grade in borings M-3 and M-4. Although the contact between the sandy silt beneath the interbedded sediments and the lower sand is gradational, the fine, cross-bedded sand begins at depths of approximately 22 and 19.5 feet in borings M-3 and M-4, respectively.

Soils above and below the interbedded materials are dry. At the time of sampling, the interbedded sediments were moist but not saturated. The higher water contents observed in these materials are characteristic of clayey soils. Gradation curves shown on Figure 10 indicate the silt and clay contents of representative samples from these soils.

Because of the relatively high clay content, the interbedded silts observed in borings M-3 and M-4 act as a local confining layer to vertical infiltration. The extent of these materials beneath the waste disposal area cannot be extrapolated from the borings taken for this investigation. However, if the interbedded silts were continuous, evidence of a perched water table would probably have been observed in the overlying fine to coarse sands. In fact, the soils above the interbedded silts were observed to be unsaturated, indicating that these materials are not laterally extensive. Even if they are present beneath the drum disposal area, it cannot be assumed they are connected to the interbedded silts encountered in either boring M-3 or M-4. Based upon the subsurface variability demonstrated by the previous exploration borings and water supply test wells, such continuity is doubtful.

Permeability

The hydraulic conductivity (permeability) of the water table aquifer beneath the waste disposal area was estimated from laboratory particle size data shown on Figures 9 and 10. Field permeability tests were not considered feasible because 1) the response of the fine sand aquifer to low-volume pumping or bailing tests would be too rapid for reliable measurement, and 2) injection (constant or falling head) tests would introduce foreign water to the aquifer prior to sampling for ground water analysis. Estimates of permeability using grain-size data are most applicable to uniformly graded sands such as those occurring below the water table in the study area.

Several empirical methods of determining permeability from grain-size data are described in ground water literature. The simplest, Hazen's Approximation, may be written

$$K = Ad_{10}^{2}$$

where K is permeability in cm/sec, d_{10} is the particle size at which 10 percent of the soil particles are finer (by weight), and A is 100. Using this equation, permeability of the six soil samples below the water table is estimated to range from 1.7×10^{-3} to 5.5×10^{-3} cm/sec.

As shown by the equation, Hazen's Approximation relies on a single grain size value from the gradation curve. Methods which also consider particle-size distribution have greater validity for non-uniform soils. Permeabilities for the same six soil samples were calculated using two such methods. The first is a modification of Hazen's Approximation, proposed by Beyer (1969), which replaces the constant A with a proportionality constant, C, based upon the uniformity coefficient, d_{60}/d_{10}. The proportionality constant is determined graphically. For the same six soil samples, C ranges from 101 to 108, resulting in slightly higher estimates of permeability than Hazen's Approximation.

Masch and Denny (1966) recommended a procedure which uses the median grain size, d_{50}, and the inclusive standard deviation, σ_I, as a measure of soil uniformity, where

$$\sigma_I = \frac{d_{16}-d_{84}}{4} + \frac{d_5-d_{95}}{6.6}$$

Gradation curves used to determine d_5, d_{16}, d_{50}, d_{84}, and d_{95} are plotted using the ϕ-scale devised by Krumbein. Once d_{50} and σ_I are known, K is determined graphically from a family of experimental type curves. Permeabilities determined using this method range from 7.2×10^{-3} to 9.7×10^{-3} cm/sec.

Estimated permeability values calculated using all three empirical methods are summarized in Table 2.

TABLE 2

ESTIMATED PERMEABILITY
FROM GRAIN-SIZE DATA

Well No.	Sample No.	Percent Passing No. 200 Sieve	Hazen's Method	Beyer's Method	Masch & Denny's Method
M-1	11	10.0	4.9×10^{-3}	5.3×10^{-3}	8.5×10^{-3}
M-1	12	50.3	1.7×10^{-3}	1.8×10^{-3}	7.2×10^{-3}
M-2	10	11.7	5.0×10^{-3}	5.2×10^{-3}	9.2×10^{-3}
M-2	11	14.7	5.5×10^{-3}	5.7×10^{-3}	9.0×10^{-3}
M-3	13	12.9	4.9×10^{-3}	5.0×10^{-3}	9.7×10^{-3}
M-4	11	11.4	4.9×10^{-3}	5.0×10^{-3}	9.0×10^{-3}

Notes:

1. Methods of computing permeability are described in the text.
2. Gradation curves for the tested soil samples are shown on Figures 9 and 10. All samples are fine sand with varying amounts of silt.

Ground Water Flow

Ground water levels measured in monitoring wells M-1, M-2, M-3, and M-4 were used to prepare the ground water contour map shown on Figure 2. Ground water levels listed on the map were measured approximately 1 week after the wells were developed. These values compare favorably to the levels observed during drilling and measured before development.

Ground water flow lines constructed orthogonal to the ground water contours on Figure 2 show the horizontal direction of ground water flow. Based upon the map, ground water is flowing to the southeast across the study area toward the valley of the River Raisin. The hydraulic gradient along the flow lines averages 0.019, or 19 feet in 1,000 feet.

Ground water flow rates may be estimated from the relation

$$\bar{V} = \frac{Ki}{n_e}$$

where $\bar{V}$ is the average linear discharge or flow rate, K is hydraulic conductivity or permeability, i is the hydraulic gradient, and n_e is effective porosity. (Permeability is a property only of the porous medium through which a fluid is moving while hydraulic conductivity is a function of both the medium and the fluid. Although not absolutely correct, the two terms are used synonymously in this discussion.) Based upon the permeabilities listed in Table 2, a value of 6×10^{-3} is assumed for the calculation of flow rate. Effective porosity in unconfined aquifers is essentially equal to specific yield, or the volume of water released from storage under the influence of gravity per unit volume of saturated soil. For uniform sand, specific yield is commonly assumed to be 0.20. Therefore, using the average hydraulic gradient of 0.019, the flow rate is computed to be 5.7×10^{-4} cm/sec or 1.6 ft/day. Thus, ground water is moving beneath the waste disposal area at a rate of approximately 2 ft/day.

VI. REFERENCES

Beyer, W./Schweiger, 1969. Zur Bestimmung des entwässerbaren. Porenantella der Grundwasserleiter (For the determination of the "effective" porosity of aquifers): Wasserwirtsch. Wassertechn. 19, No. 2, pp. 57-60.

Masch, F. D., and K. J. Denny. 1966. Grain-size distribution and its effect on the permeability of unconsolidated sands: Water Resources Research, Vol. 2, pp. 665-677.

Twenter, F. W., 1975. Southeastern Michigan water-resources study: Ground water and geology: U.S. Geological Survey and U.S. Army Corps of Engineers.

GENERAL NOTES FOR LOG OF BORINGS

GRANULAR SOILS

COMPONENT	SIEVE SIZE RANGE
BOULDERS	8 in.
COBBLES	8 in. – 3 in.
GRAVEL (COARSE)	3 in. – 3/4 in.
GRAVEL (FINE)	3/4 in – #4 (4.75 mm)
SAND (COARSE)	#4 – #10 (2.00 mm)
SAND (MEDIUM)	#10 – #40 (0.425 mm)
SAND (FINE)	#40 – #200 (0.074 mm)
SILT	#200

RQD INTERPRETATION

RQD = TOTAL LENGTH OF RECOVERED CORE PIECES MEASURING 4". OR MORE IN LENGTH, EXPRESSED AS A PERCENTAGE OF THE TOTAL LENGTH OF THE CORE RUN.

DESCRIPTIVE TERM	RQD, PERCENTAGE
VERY POOR	0 – 25
POOR	26 – 50
FAIR	51 – 75
GOOD	76 – 90
EXCELLENT	91 – 100

DEGREE OF COMPACTNESS OF GRANULAR SOILS

N – BLOWS/FT	DESCRIPTION
<4	VERY LOOSE
4 – 9	LOOSE
10 – 29	MEDIUM DENSE
30 – 49	DENSE
50 – 80	VERY DENSE
>80	EXTREMELY DENSE

CONSISTENCY OF COHESIVE SOILS

N – BLOWS/FT	UNCONFINED COMPRESSIVE STRENGTH, qu, TSF	CONSISTENCY
<2	qu < 0.25	VERY SOFT
2 – 3	0.25 ≤ qu < 0.50	SOFT
4 – 7	0.50 ≤ qu < 1.00	MEDIUM STIFF
8 – 14	1.00 ≤ qu < 2.00	STIFF
15 – 30	2.00 ≤ qu < 4.00	VERY STIFF
>30	4.00 ≤ qu	HARD

N = NUMBER OF BLOWS OF A 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE A 2 IN. O.D. SPLIT-SPOON SAMPLER ONE FOOT.

LEGEND

- ⊠ – STANDARD PENETRATION TEST
- ■ – UNDISTURBED SOIL SAMPLE
- ◪ – DISTURBED SOIL SAMPLE
- □ – LOST SOIL SAMPLE
- CR – CORE RUN NO.
- 22 – BLOWS PER FOOT
- P – HYDRAULICALLY PUSHED
- TV – TORVANE TEST
- UC – UNCONFINED COMPRESSION TEST
- G – SPECIFIC GRAVITY
- C – CONSOLIDATION TEST
- PN – PENETROMETER
- BG – BAG SAMPLE

CLASSIFICATION TERMINOLOGY

DESCRIPTIVE TERM	PERCENT BY WEIGHT
TRACE	0-9
LITTLE	10-19
SOME	20-34
AND	35-50

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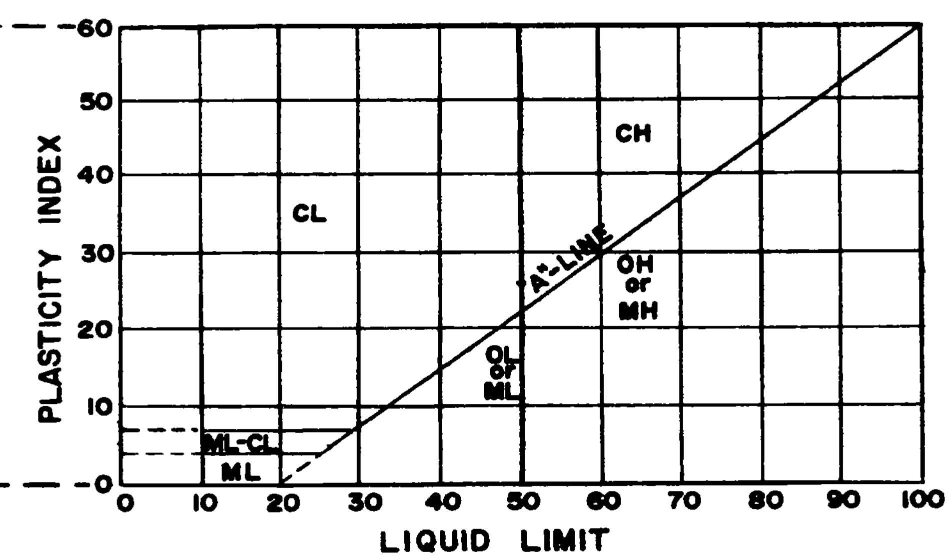
KEY TO LOG OF BORINGS

FIGURE 3

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVEL (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE.	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE				SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE.	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND CLAY MIXTURES.
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE.	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS.
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

GRAPH SYMBOL	LETTER SYMBOL	ROCK CLASSIFICATION
	SH	SHALE
	SI	SILTSTONE
	SS	SANDSTONE
	LS	LIMESTONE

PLASTICITY CHART



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CLASSIFICATION CHARTS

FIGURE 4

BORING M-1

SURFACE ELEVATION 780.5' NGVD
PLANT COORDINATES: N48,826
E25,337

Column headings: ELEV. IN FEET | OTHER TESTS | SHEAR STRENGTH TEST (PSF) | ATTERBERG LIMITS: LIQUID LIMIT, PLASTICITY INDEX | FIELD MOISTURE CONTENT (%) | DRY DENSITY (PCF) | PERCENT PASSING #200 SIEVE | RECOVERY (%) | WATER LEVEL DURING DRILLING | DEPTH IN FEET (5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60) | BLOW COUNT | SAMPLES | SYMBOLS | DESCRIPTION

Percent passing #200 sieve: 2.5; 14.7; 50.3

Blow counts (in order of depth): 26, 23, 23, 21, 32, 49, 57, 55, (42), (22/6"), 32

ELEV. IN FEET	SYMBOLS	DESCRIPTION
780.5	SP	Fill, brown fine to medium SAND, trace coarse sand and fine gravel, concrete fragments noted.
	SP	Brown fine to coarse SAND, trace fine gravel, occasional thin layer of coarse sand noted. (medium dense)
764.0	SP • SM	Light brown fine SAND, trace to little silt, dry. (dense to very dense)
		Grades to moist.
749.5	SM	Light brown fine SAND, little silt, saturated. (dense)
		Grades to fine SAND and silt.
740.5		Boring terminated at 40.0' on 6/08/82. Water level encountered at approx. 32.5' during drilling.

NOTES:

1. A 2-inch PVC monitoring well was installed in the borehole with 4 feet of Johnson, continuous slot screen set between depths of 34.5 to 38.5 feet. Slot size is 0.006 inch. A complete installation summary is given in Table 1.

2. Blow counts in parentheses are not representative of the in situ soils.

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LOG OF BORING M-1

FIGURE 5

BORING M-2

SURFACE ELEVATION 775.0' NGVD
PLANT COORDINATES: N 48,483
E 25,572

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT PASSING #200 SIEVE	RECOVERY (%)	WATER LEVEL DURING DRILLING	DEPTH IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
775.0										0				Brown fine to coarse SAND, little silt or clay, trace fine gravel (topsoil).
										5	14	X	SP	Light brown fine to coarse SAND. (medium dense)
										10	9	X		
										15	19	X		
758.5										20	27	X	SP • SM	Gray-brown fine SAND, trace to little silt, cross-bedded, dry. (medium dense to dense)
							19.6			25	27	X		
											26	X		
											33	X		
										30	38	X		Grades to moist.
									▼		(51)	X		Saturated.
										35				
							11.7				(56)	X		Grades to tan to orange-brown.
733.5							10.0			40	(60)	X		Grades to gray, less silt.
										45				Boring terminated at 41.5' on 6/09/82. Water level encountered at approx. 33.3' during drilling.
										50				
										55				
										60				

NOTES:

1. A 2-inch PVC monitoring well was installed in the borehole with 5 feet of Johnson, continuous slot screen set between depths of 35.4 to 40.4 feet. Slot size is 0.006 inch. A complete installation summary is given in Table 1.

2. Blow counts in parentheses are not representative of the in situ soils.

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LOG OF
BORING M-2

FIGURE 6

BORING M-3

SURFACE ELEVATION 770.9' NGVD
PLANT COORDINATES: N48,647
E25,998

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT PASSING #200 SIEVE	RECOVERY (%)	WATER LEVEL DURING DRILLING	DEPTH IN FEET	BLOW COUNT	SAMPLES
770.9										0		
										5	20	☒
763.4												
										10	42	☒
		PN=2500	24.7	11.2			87.3				22	☒
		PN=1500-2000	23.6	0.2			94.8			15	18	☒
754.7											(57)	☒
							59.6			20	(148)	☒
748.5												
										25	44	☒
										30	69	☒
									▼		27/8"	☒
										35	39	☒
731.4							12.9			40	105	☒
										45		
										50		
										55		
										60		

SYMBOLS	DESCRIPTION
SP	Brown medium to coarse SAND, trace fine gravel, coarse gravel noted. (medium dense)
ML • CL	Interbedded tan to orange-brown SILT, some fine sand; tan SILT, some clay, little fine to medium sand; and gray clayey SILT to SILTY CLAY, trace fine sand; occasional silt or fine sand partings; contacts are gradational; high moisture content, but not saturated. (very stiff)
ML • SM	Tan SILT, some fine sand, moist to dry. Grades to fine SAND, some silt, dry.
SP • SM	Light brown fine SAND, little silt, cross-bedded, dry. (dense to very dense) Saturated. Grades to tan, a few thin layers of medium sand noted. Grades tan to yellow-brown, little silt. (extremely dense)

Boring terminated at 39.5' on 6/09/82. Water level encountered at appox. 31.5' during drilling.

NOTES:

1. A 2-inch PVC monitoring well was installed in the borehole with 5 feet of Johnson, continuous slot screen set between depths of 34.4 to 39.4 feet. Slot size is 0.006 inch. A complete installation summary is given in Table 1.

2. Blow counts in parentheses are not representative of the in situ soils.

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LOG OF BORING M-3

FIGURE 7

BORING M-4

SURFACE ELEVATION 771.4' NGVD
PLANT COORDINATES: N 48,556
E 25,827

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT PASSING #200 SIEVE	RECOVERY (%)	WATER LEVEL DURING DRILLING	DEPTH IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
771.4										0				(No topsoil)
										5	17	⊠	SP	Brown medium to coarse SAND, trace fine gravel, trace silt or clay. (medium dense)
764.4							99.2			10	(41)	⊠	ML · CL	Interbedded tan to orange-brown SILT, no sand; tan to orange-brown SILT, trace to some fine sand; gray-brown SILTY CLAY, plastic; mottled gray-brown and orange-brown clayey SILT, trace fine to coarse sand with dry silt partings; contacts are gradational; high moisture content.
											(28)	⊠		
		PN=3750-4500	23.4	5.9			87.7			15	(33)	⊠		
		PN=3750-4500	18.0	1.8			92.7				(30)	⊠		
753.9											83/6"	⊠	ML SM	Tan to orange-brown SILT, some fine sand grading to fine SAND, some silt, moist.
751.9										20	(133)	⊠	SP · SM	Tan to light brown SAND, little silt, moist to dry
							36.8			25	42	⊠		Grades to light gray-brown some silt, cross-bedded, dry. (dense to very dense)
									▼	30	(46)	⊠		Grades to tan, trace to little silt.
											41	⊠		Saturated
							11.4			35	58	⊠		Grades to gray-brown.
											62	⊠		
731.4										40				Boring terminated at 40.0' on 6/10/82. Water level encountered at appox. 32.0' during drilling.
										45				
										50				
										55				
										60				

NOTES:
1. A 2-inch PVC monitoring well was installed in the borehole with 5 feet of Johnson, continuous slot screen set between depths of 35.2 to 40.2 feet. Slot size is 0.006 inch. A complete installation summary is given in Table 1.

2. Blow counts in parentheses are not representative of the in situ soils.

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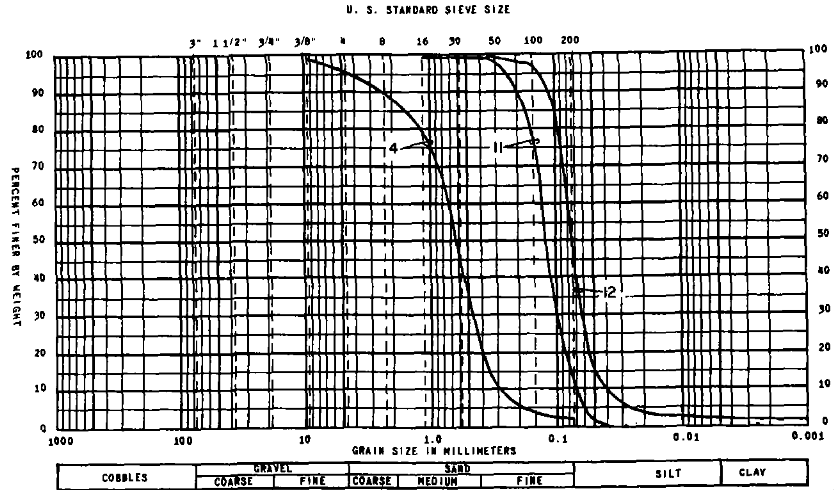
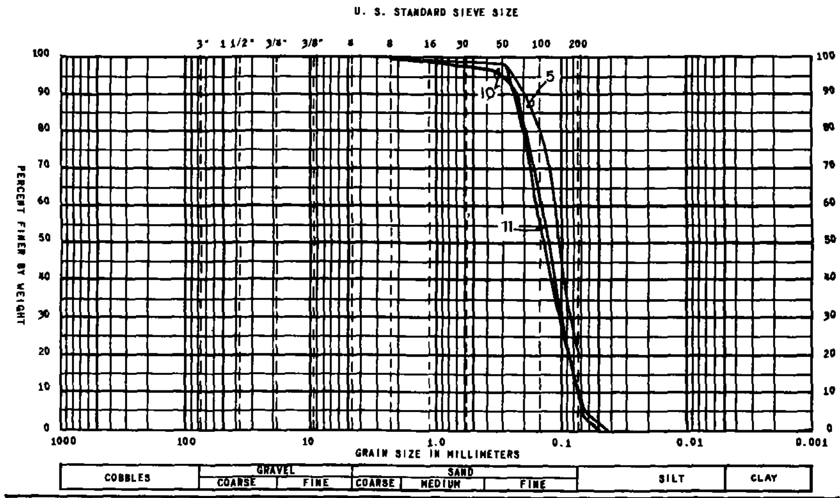
LOG OF
BORING M-4

FIGURE 8



BORING	DEPTH		CLASSIFICATION		PL	PI	
M-1	13.5'-15.0' (4)	SP	FINE-COARSE SAND, TRACE FINE GRAVEL				
M-1	36.0'-37.0' (11)	SM	FINE SAND, LITTLE SILT				
M-1	38.5'-40.0' (12)	SM	SILTY FINE SAND				



BORING	DEPTH		CLASSIFICATION	LL	PL	PI	
M-2	23.5'-25.0' (5)	SM	FINE SAND, LITTLE SAND				
M-2	38.5'-40.0' (10)	SP-SM	FINE-MEDIUM SAND, LITTLE SILT				
M-2	40.0'-41.5' (11)	SP-SM	FINE SAND, LITTLE SILT				

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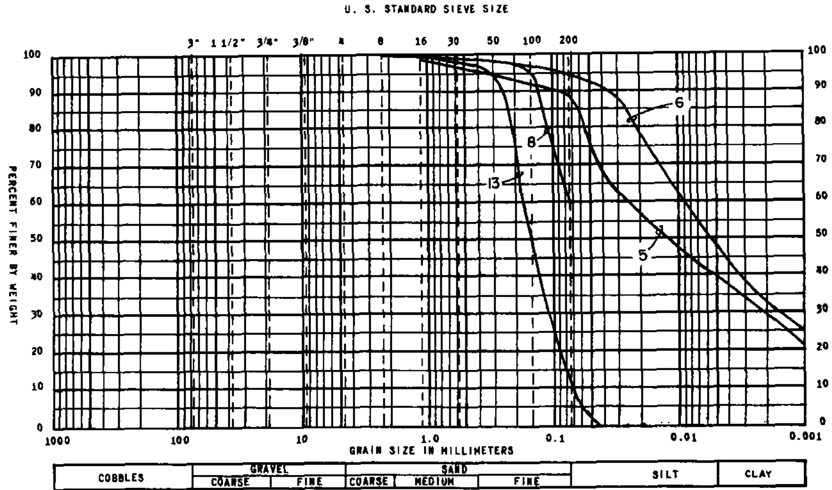
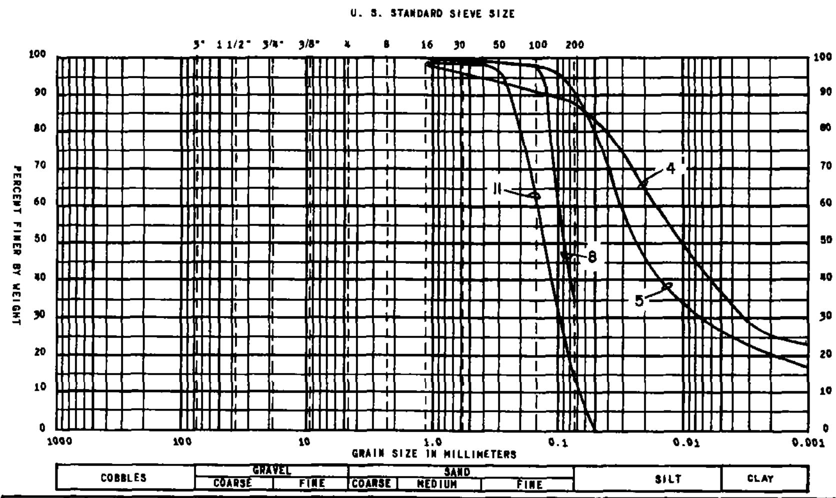
GRADATION CURVES
FOR BORINGS M-1, M-2

FIGURE 9



BORING	DEPTH		CLASSIFICATION	LL	PL	PI	
M-3	11.7'-12.6' (5)	CL	SILTY CLAY, LITTLE FINE-MED SAND	24.7	13.5	11.2	
M-3	13.5'-15.0' (6)	ML	CLAYEY SILT, TRACE FINE-MED SAND	23.6	23.4	0.2	
M-3	18.5'-20.0' (8)	ML	SANDY SILT				
M-3	38.0'-39.5 (13)	SM	FINE-MEDIUM SAND, LITTLE SILT				



BORING	DEPTH		CLASSIFICATION	LL	PL	PI	
M-4	13.5'-15.0' (4)	ML-CL	CLAYEY SILT, LITTLE FINE-MED. SAND	23.4	17.5	5.9	
M-4	16.0'-17.5' (5)	ML	CLAYEY SILT, TRACE FINE-MED. SAND	18.0	16.2	1.8	
M-4	26.0'-27.5' (8)	SM	SILTY FINE SAND				
M-4	36.0'-37.5' (11)	SP-SM	FINE-MEDIUM SAND, LITTLE SILT				

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GRADATION CURVES
FOR BORING M-3, M-4

FIGURE 10

R-2194

HYDROGEOLOGIC STUDY

FOR

EVAPORATION AND SETTLING BASIN

SWS SILICONES CORPORATION

ADRIAN, MICHIGAN

Reviewed by:

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September, 1980

TABLE OF CONTENTS

1.0 GENERAL

1.1 INTRODUCTION

This report presents the results of our hydrogeologic survey for the evaporation and settlement basin. The survey included compilation of existing data, drilling and sampling of five borings to approximately 40 feet in depth, installation of nine monitoring wells, and a soils laboratory testing program to determine engineering properties.

1.2 PURPOSE AND SCOPE

The hydrogeologic survey was initiated to define the groundwater regime near the abandoned evaporation and settling basin. The scope of the hydrogeologic survey was planned in discussions between P. Roux of Stauffer Chemical Company, J. Lorenzen and L. Andre of SWS Silicones Corporation, and R. Wagner of Commonwealth Associates Inc. (CAI) and detailed in a letter to L. Andre from C. H. D. Henriksen dated June 25, 1980. The following summarizes the scope of work.

1. Installation of nine monitoring wells in accordance with procedures presented in Appendix B.

2. Preparation of groundwater contour map of the perched water table and on the normal water table if enough data is available on the latter.

3. Preparation of a contour map of the top of the clay layer and an isopach map showing the estimated thickness of the clay layer.

4. Preparation of an up-to-date topographic map of the study area.

5. Preparation of a formal report describing the findings of the hydrogeologic survey.

1.3 SITE LOCATION

The SWS Silicones Plant is located approximately 50 miles southwest of Detroit, 38 miles southeast of Jackson, Michigan, and 40 miles northwest of Toledo, Ohio. The site is roughly 4 miles south of M-50 in Tecumseh, Michigan, 3 miles north of Adrian, Michigan, and 3 miles east of M-52. Locations of the site and study area are shown on Plate 1 - General Site Location, and Plate 2 - Boring Location Plan.

The evaporation and settling basin is on the eastern edge of the present plant property approximately 1,100 feet south of the nearest major road (Sutton Road). An abandoned township road located approximately 200 feet east of the basin has been chained off to traffic at Sutton Road. The New York Central Railroad parallels the east side of the basin approximately 50 feet from the east dike. The River Basin at its closest point to the evaporation and settling basin is 800 feet south of the basin.

1.4 SITE HISTORY

The SWS Silicones Plant was constructed during 1964 and 1965. A MENONCES AREA pilot plant was constructed and abandoned after completion of the existing facility. The evaporation and settling basin was constructed in 1971 and used in the operation of the plant until 1974 when the plant process was changed and the basin was no longer required. From that time until the spring of 1980, the basin was used to collect various plant spills and waste products from the cleaning of plant facilities. The DNR has been aware of the basin's existence since construction and included it in some of their reports as early as 1972.

1.5 EXISTING DATA

Data from prior investigations included published literature, soil borings for construction of the plant in 1964, exploration for water wells in 1964, and soil borings for waste storage tanks in 1980.

1.5.1 PUBLISHED LITERATURE

The available published literature for the study area included the U.S.G.S. 7-1/2' topographic map - Tecumseh South, Michigan, and the Regional Geologic Map No. 8 Fort Wayne, Indiana Sheet, Parts A and B published by the Indiana State Geological Survey. The geologic map does not include the study area but extends to within 3 miles of the site.

1.5.2 PLANT BORINGS - 1964

The soil borings for the plant are generally northwest of the evaporation and settling basin. Approximately 38 borings were drilled to depths from 15 to 40 feet. Depth to the normal water table as recorded on the boring logs averaged approximately 33 feet in the uplands.

1.5.3 EXPLORATION WATER WELL BORINGS - 1964

Exploration for water was initiated during construction of the site and included five exploration wells and one 14-inch water well. The first exploration well was approximately 200 feet west of the evaporation and settling basin and extended 296 feet into rock for a total depth of 508 feet. The other borings were farther away from the study area but showed approximately the same overall stratigraphy. These borings varied in depth from 154 to 240 feet. The approximate location of exploration Water Well 1 (WW-1) is shown on Plate 2. The driller's log as written by John Roberts Well Drilling indicates the following materials were encountered:

Depth (Feet)	
0-85	Fine sand
85-102	Blue clay
102-108	Hard pan
108-119	Fine sand
119-131	Clay
131-134	Gravel and sand
134-138	Clay
138-176	Fine sand
176-191	Clay and gravel
191-194	Clay
194-212	Gravel
212-421	Blue shale
421-508	Blue shale, gray limestone, and sandstone

1.5.4 BORINGS FOR WASTE STORAGE TANKS - 1980

Seven borings numbered B-1 through B-7 were drilled and sampled at the site on June 5 and 6, 1980. The borings varied in depth from 12 to 40 feet and were drilled using truck-mounted rotary drilling equipment utilizing flight augers and rotary wash bits to advance the hole. The soils were sampled at 2-1/2 to 5-foot intervals using either the Standard Penetration test or thin-walled Shelby tubes. The drilling operations were supervised by a CAI engineer who maintained continuous boring logs of the soils encountered. Boring locations are shown on the Boring Location Plan, Plate 2. Boring B-6 was drilled in a potential clay borrow area located approximately 1,100 feet from the tank foundation and evaporation and settling basin area and is not shown on Plate 2. Detailed boring logs of the B-Series borings are presented on Plates A-1 through A-7 in Appendix A.

During the tank foundation study, selected undisturbed and disturbed soil samples extracted from the borings were subjected to laboratory testing in CAI's soils laboratory in Jackson, Michigan. This test data was correlated with the data obtained from borings for installation of the monitoring wells (OW-Series borings) to show uniformity of soils across the study area. Soil tests included sieve analysis, moisture, density, Atterberg limits, unconfined compression tests, and consolidation tests. All soil test results are presented on the appropriate boring logs in Appendix A. Graphical representation of the gradation curves and consolidation test data are presented on Plate A-13 and Plate A-15, respectively, in Appendix A. Descriptions of all tests are included in Appendix A.

The data from the B-Series borings were used to determine the stratigraphy and soil characteristics of the materials encountered and to develop preliminary contours of the groundwater surface of the perched water table. Other data obtained from these borings include depth, thickness, uniformity, and permeability of the clay layer and depth to normal water table.

2.0 FIELD AND LABORATORY INVESTIGATION

2.1 TEST BORINGS

Data obtained from the waste storage tank borings (B-Series) were used to locate nine additional borings numbered OW-1 through OW-5 which were drilled between June 19 and 27, 1980. Borings OW-1 through OW-4 each included a deep and a shallow boring. The borings varied in depth from 16 to 40 feet and were drilled using truck-mounted rotary drilling equipment utilizing flight augers and rotary wash bits to advance the hole. The soils were sampled at 2-1/2 to 5-foot intervals in the deep borings using the Standard Penetration test. No sampling was performed in the shallow borings. The deep and shallow borings in each set were drilled within 5 feet of each other.

The drilling operations were supervised by a geologist from CAI who maintained continuous boring logs of the soils encountered. Each boring was developed into a monitoring well by installing a preslotted screen and PVC casing according to procedures described in Appendix B. Appendix B also notes special drilling methods that were used to prevent contamination of the lower aquifer by water from the upper saturated strata.

Boring locations are shown on the Boring Location Plan - Plate 2. Detailed boring logs are presented on Plates A-8 through A-12 in Appendix A.

2.2 LABORATORY TESTING

Selected, disturbed soil samples extracted from the OW-Series borings were subjected to laboratory testing in CAI's soils laboratory in Jackson, Michigan. Soil tests consisting of sieve analysis, moisture content, and Atterberg limits were compared with test results of borings for the waste storage tanks. In addition, falling head permeability tests were performed on selected undisturbed samples of the silts above and below the clay layer.

The sample of silt overlying the clay was obtained from the tank foundation excavation. A Shelby tube was hydraulically pushed into the strata by a backhoe and then pulled out. The sample of silt underlying the clay layer was selected from the Shelby tubes taken during the B-Series borings.

All soil test results are presented on the appropriate boring logs in Appendix A. Graphical representation of the gradation curves for the OW-Series borings are presented on Plate 14. A summary of the Atterberg limits for both the B-Series and OW-Series borings is presented in Table 1.

3.0 SITE CONDITIONS

3.1 LOCATION OF STUDY AREA

The hydrogeologic study was performed for the evaporation and settling basin which is located in a rectangular area southeast of the main plant facilities. The study area is bounded on the east by the closed township road that forms the east property line of SWS Silicones, on the south by the River Raisin valley, on the west by the road to the river water intake, and on the north by the abandoned pilot plant.

3.2 SURFACE CONDITIONS

The process water lagoon, cooling lagoons, evaporation and settling basin, transformer, sewage plant, cooling water pumphouse and associated underground piping, and an electrical duct run all lie within the study area. In addition, two waste storage tanks are under construction immediately west of the evaporation and settling basin. This area will have a final grade at approximately Elevation 753. The drainage ditch northwest of the evaporation and settling basin will be rerouted around the waste storage tank area. The New York Central Railroad traverses north-south through the eastern edge of the study area and parallels the east dike of the evaporation and settling basin.

The topography of the majority of the study area has been affected by construction activity. Plate 4 shows topography of the majority of the study area prior to construction of the process water lagoon and evaporation and settling basin.

The existing topography as presented on Plate 2 shows a gently sloping terrain from Elevation 768 in the main plant area on the northwest to Elevation 754 in the main study area. The main study area is relatively flat except for the constructed dikes in the basin area, the ditches for drainage, and the railroad fill. The southern and southeastern portions of the study area slopes rather steeply (approximately 3H:1V) from Elevation 752 to approximately Elevation 720 feet where the River Raisin valley dissects the uplands.

The preconstruction topography was much the same except that several deep gullies dissected the southern portion of the upland. These gullies were filled in to construct the process water lagoon.

3.3 EXISTING IMPOUNDMENT FACILITIES

3.3.1 EVAPORATION AND SETTLING BASIN

The evaporation and settling basin consists of a partially excavated and partially diked structure. The depth is estimated to vary from approximately 4 feet on the north to 6-1/2 feet on the south. The basin is unlined and has no overflow channel or open discharge pipe to surface channels.

3.3.2 COOLING LAGOONS

The cooling lagoons consist of excavated structures. The bottom of the lagoons are approximately at Elevation 741.5 feet and the lagoons have a normal pool elevation of approximately 750 feet.

The lagoons have artificial liners to prevent loss of cooling water.

3.3 PROCESS WATER LAGOON

The process water lagoon is predominantly located on backfill. The bottom and sides are lined with a 12-inch thick clay layer to prevent seepage into the groundwater regime. The northwest corner area of the lagoon has a tile drain behind the clay liner to intercept the perched groundwater. The drain empties into a surface water channel in the River Raisin valley on the southwest corner of the study area.

3.4 SUBSURFACE CONDITIONS

The subsurface profiles in the study area as developed from the boring program show the stratigraphy to be relatively uniform. The soils strata are gently sloping to the River Raisin valley (south to southeast) and are relatively uniform in thickness throughout the study area. Five distinct soil layers were identified on the uplands between ground level and the ultimate depth (40 feet) of the borings. Following is a detailed description of these layers. The subsurface profiles are presented on Plate 3.

Surface soils encountered in the borings are 4 to 9 feet thick and consist of fine to coarse and fine to medium sands with trace to some fines. The upper 1 to 4 feet appear to be reworked and have been classified as fill on the boring logs. Differentiation between natural in-situ soils and the reworked materials is somewhat difficult. These soils ranged from loose to dense.

Underlying the surface sandy soils is a layer from 5 to 13 feet thick that consists of brown to gray silt with a trace to some fine sand. The top of this layer varies from Elevation 760 feet in the northwest to 735 feet on the southeast edge of the proposed construction area. The strata reaches its maximum thickness of 13 feet in B-4 in the northwest and in general thins to approximately 5 feet at the southern edge of the construction area. These soils ranged from loose to dense with a perched water table encountered either slightly above or within this soil strata. Groundwater contours on the perched water table are presented in Plate 7. A falling head permeability test performed on a Shelby tube sample of the material obtained from the waste storage tank excavation indicates a permeability on the order of 3×10^{-5} cm/sec.

Underlying the silt strata is a layer from 3 to 6 feet thick that consists of gray silty clay to clay. The top of the clay layer as determined in the borings varies from Elevation 747 feet in the northwest to 727 feet in the southeast. A contour map on top of the clay layer is presented on Plate 5. The strata is relatively uniform across the proposed construction area and becomes thicker towards the river. An isopach map of the clay layer is presented on Plate 6. The clay was medium stiff to stiff with an average liquid limit of $\approx$ 32 and an average plasticity index of $\approx$ 14. The dry density of the clay ranged from 98.8 to 112.7 lbs/cu ft. Unconfined compression tests indicate the clay has a shear strength of approximately 1,750 psf. A consolidation test was performed to determine the amount of settlement that could be anticipated from the design loads of the tank foundations. The permeability of the clay layer as derived from the consolidation test at the existing overburden pressure was determined to be on the order of 1×10^{-7} cm/sec.

Underlying the clay strata is an approximately 10-foot thick layer of gray-brown to gray silt with some fine sand. The top of the silt layer varies from Elevation 743 in the northwest to 728 in the east. The silt is generally dense and is saturated below the normal water table. Groundwater contours on the normal water table are presented on Plate 8. A falling head permeability test performed on a Shelby tube sample obtained from the B-Series borings indicates a permeability on the order of 1×10^{-6} cm/sec.

Underlying the second silt strata is a layer of brown to gray fine sand with a trace of silt and medium sand. Boring B-1 penetrated approximately 13 feet of this layer prior to termination of the boring. The sand is very dense and saturated.

The strata encountered by the B-Series and OW-Series borings are all Wisconsinan age glacial deposits. The sands and silts are believed to be valley train deposits and the silty clay and clay a lacustrine deposit. With the exception of the sandy soil at the surface, the layers of soils encountered are relatively uniform in texture, density, and classification across the study area.

3.5 GROUNDWATER

Two water levels were encountered in the borings. In all but Borings B-6 and OW-5, a perched water table was encountered above the clay layer and a normal water level below the clay layer. Boring B-6 was in a potential clay borrow area approximately 1,100 feet from the study area and Boring OW-5 was in the floodplain. These borings did not encounter the same soil strata. Plates 7 and 8 present the groundwater surface contours of the two water levels.

3.5.1 PERCHED WATER TABLE

The perched water table generally follows the surface contour of the relatively impervious clay layer. This effect can be seen on Plates 5 and 7 where a slight depression in the clay surface corresponds to a local gradient in the perched water table. The perched water table was encountered at Elevation 756 feet in the northwest and slopes to Elevation 740 feet in the southeast. At the time of drilling the B-Series borings (June 5 and 6, 1980), the depth to the perched water table varied from 3.5 feet in Boring B-7 in the east to 8 feet in Boring B-4 in the northwest. At the time of drilling the OW-Series borings (June 20 to 27, 1980), the depth to the perched water table varied from 4.5 feet in OW-4 which is approximately 100 feet south of Boring B-7 to 10 feet in OW-2 which is in the vicinity of Borings B-1 and B-2. A test hole drilled on June 27, 1980 within 5 feet of Boring B-7 indicated a two foot drop in the depth to water from June 6, 1980 to June 27, 1980.

3.5.2 NORMAL WATER TABLE

The normal water level was encountered between approximately Elevation 715 feet on the floodplain (OW-5) and southeast part of the uplands (OW-4) and Elevation 727 feet on the northern part of the study area (OW-3). The elevation of the normal water table in the floodplain corresponds approximately to the river elevation with an increasing gradient toward the uplands. Groundwater contours on the normal water table are presented on Plate 8.

4.0 SUMMARY OF FINDINGS

The groundwater level data were collected June 5 and 6, 1980, in the B-Series borings and July 1, 1980, from the monitoring wells (OW-Series borings). On June 27, 1980, a shallow auger probe was performed adjacent to B-7. The water level was encountered at 5-1/2 feet below the ground surface. This reflected a 2-foot drop in the water level since B-7 was originally drilled. It is anticipated that all the B-Series water levels were at least 2 feet lower on July 1, 1980 when the monitoring well water levels were recorded. All the B-Series borings were grouted with a cement/bentonite/water mixture after completion of drilling.

The hydrogeologic study indicates that a relatively impermeable clay layer exists beneath the study area at relatively shallow depths. The study also shows the presence of two water tables: a perched water table on top of the clay layer and a normal water table below the clay layer. Both water tables have an overall northwest to southeast gradient towards the river valley as shown on Plates 7 and 8.

There is no water well downgradient of the evaporation and settling basin. The nearest residence which has a well is located more than 1200 feet away in the upgradient direction. It is improbable that the perched water table extends that far. Plate 6 shows the clay layer thinning to the north and west. It is unlikely that any pumping well would be located in such a shallow perched water system. The nature of the materials encountered within the perched water table (fine sandy silts) preclude the possibility of the perched water system being considered as an aquifer.

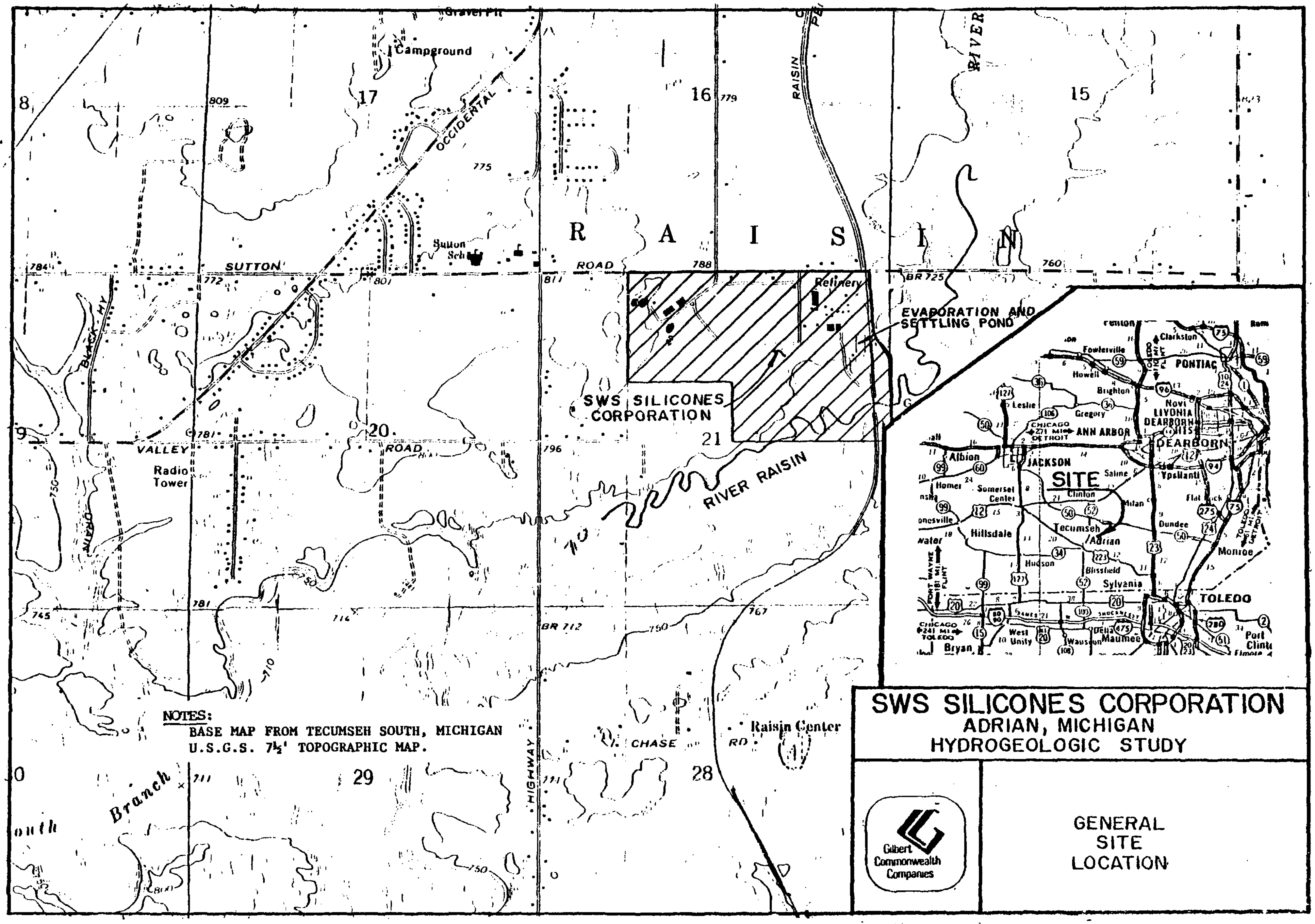
The normal water table is considered as an aquifer capable of meeting residential and agricultural requirements. This water table is isolated from the perched water table in the study area by the overlying clay layer. The River Raisin valley acts as a buffer that intercepts the flow and prevents groundwater in the perched water and normal water tables from flowing from one side of the river to the other.

In summary, the perched water system within the study area is isolated from the underlying aquifer by the clay layer. All the boring data in the study area indicates the clay is continuous throughout the study area and that it varies from 3 to 5 feet in thickness. Laboratory tests indicate permeability of the silt above the clay layer is on the order of 10^{-5} cm/sec and of the silt below the clay layer is on the order of 10^{-6} cm/sec. The clay layer has a permeability on the order of 10^{-7} cm/sec. From this data, it can be assumed that the perched water system is confined above the clay layer in the study area and that there is very little, if any, mixing of waters between the two water tables.

TABLE 1

SUMMARY OF ATTERBERG LIMITS

Boring No.	Sample No.	Depth (ft)	LL	PL	PI	Moisture Content (Percent)
OW-1	7	23.5-25.0	28.4	16.8	11.6	22.4
OW-3	4	18.5-20.0	30.4	17.4	13.0	19.2
OW-4	6	21-22.5	31.6	19.9	11.7	23.0
B-4	ST-1	18-20	28.8	17.1	11.7	17.7
B-5	ST-1	14-16	35.0	18.1	16.9	26.4



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HYDROGEOLOGIC STUDY

GENERAL SITE LOCATION

PLATE I

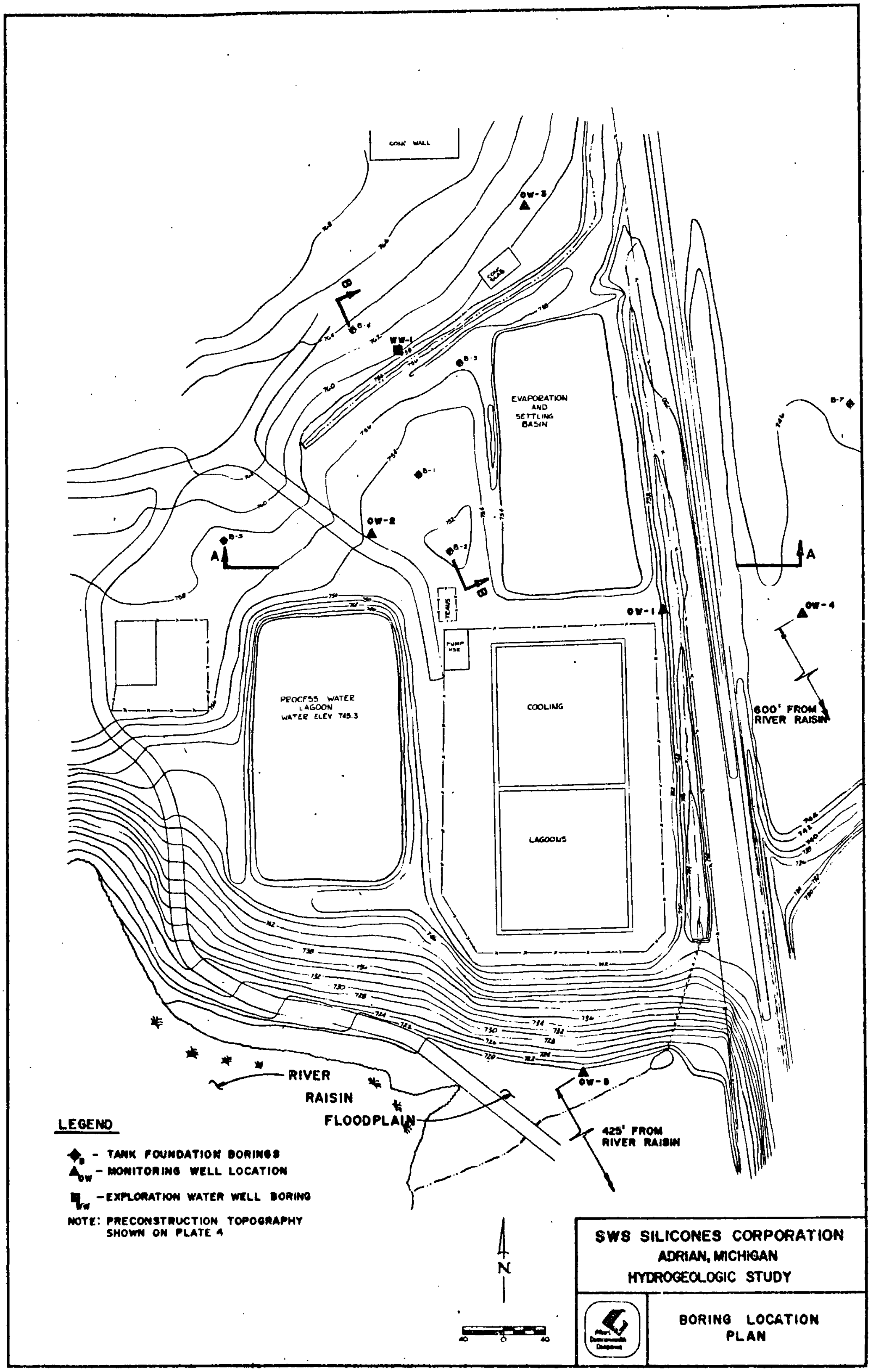
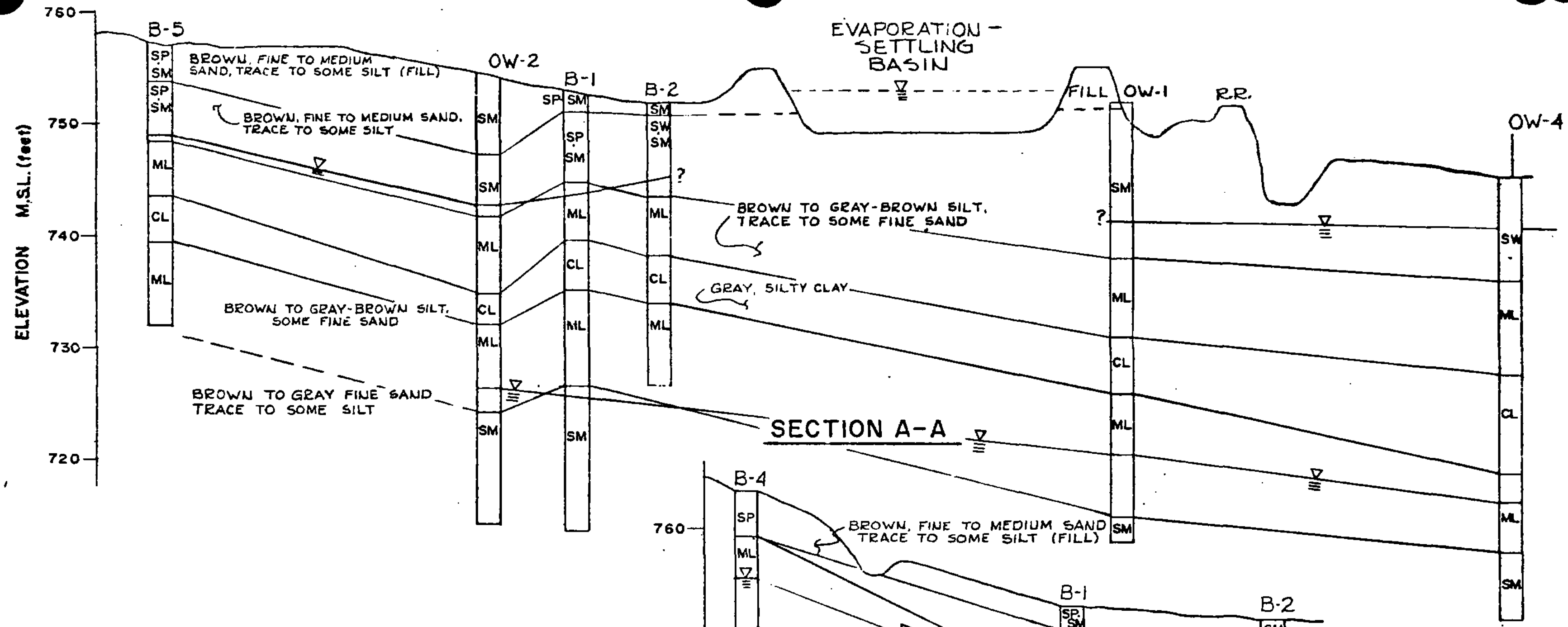
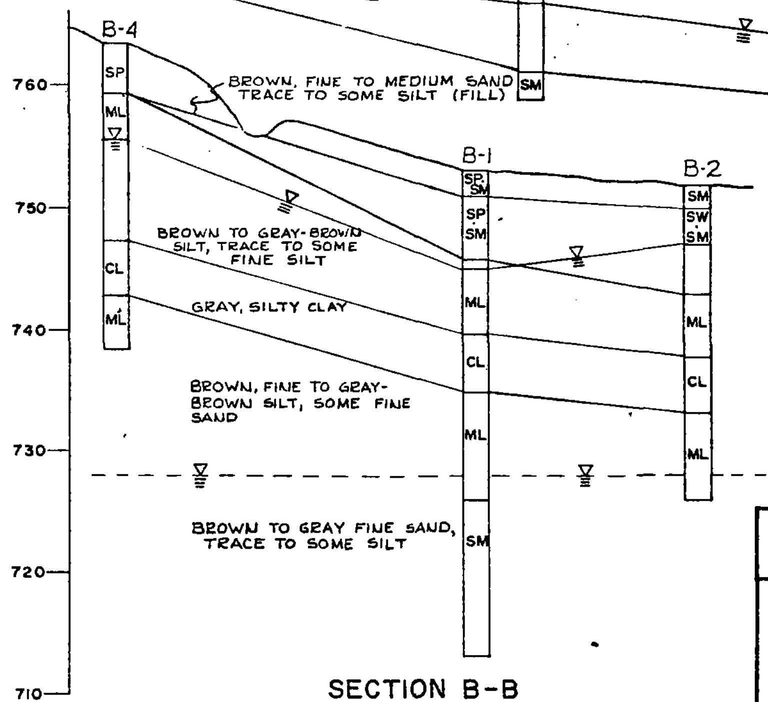

EVAPORATION AND SETTLING BASIN
PROCESS WATER LAGOON WATER ELEV 745.3
COOLING
LAGOONS
PUMP HSE
TRANS
OW-1
OW-2
OW-3
OW-4
OW-5
WW-1
B-1
B-2
B-3
B-4
B-5
B-7
A
B
600' FROM RIVER RAISIN
425' FROM RIVER RAISIN
RIVER RAISIN FLOODPLAIN
LEGEND
- TANK FOUNDATION BORINGS
- MONITORING WELL LOCATION
- EXPLORATION WATER WELL BORING
NOTE: PRECONSTRUCTION TOPOGRAPHY SHOWN ON PLATE 4
N
40 0 40
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
HYDROGEOLOGIC STUDY
BORING LOCATION PLAN

PLATE 2



SECTION A-A



SECTION B-B

50 0 50

SCALE
(HORIZONTAL)

NOTES:

THE DEPTH AND THICKNESS OF SOIL STRATA INDICATED ON THE SUBSURFACE SECTIONS WERE OBTAINED BY INTERPOLATING BETWEEN BORING LOCATIONS. INFORMATION ON ACTUAL SOIL CONDITIONS EXISTS ONLY AT THE BORING LOCATION AND IT IS POSSIBLE THAT THE SOIL CONDITIONS BETWEEN THESE LOCATIONS MAY VARY FROM THOSE INDICATED.

THE DISCUSSION IN THE TEXT IS NECESSARY FOR PROPER UNDERSTANDING OF THE NATURE OF SUBSURFACE MATERIALS.

ELEVATION OF GROUNDWATER SURFACE-∇-MEASURED JULY 1, 1980 IN MONITORING WELLS (OW- SERIES) AND JUNE 5 & 6, 1980 IN TANK FOUNDATION BORINGS (B- SERIES).

SWS SILICONES CORPORATION
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HYDROGEOLOGIC STUDY

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GENERALIZED SUBSURFACE PROFILES

PLATE 3

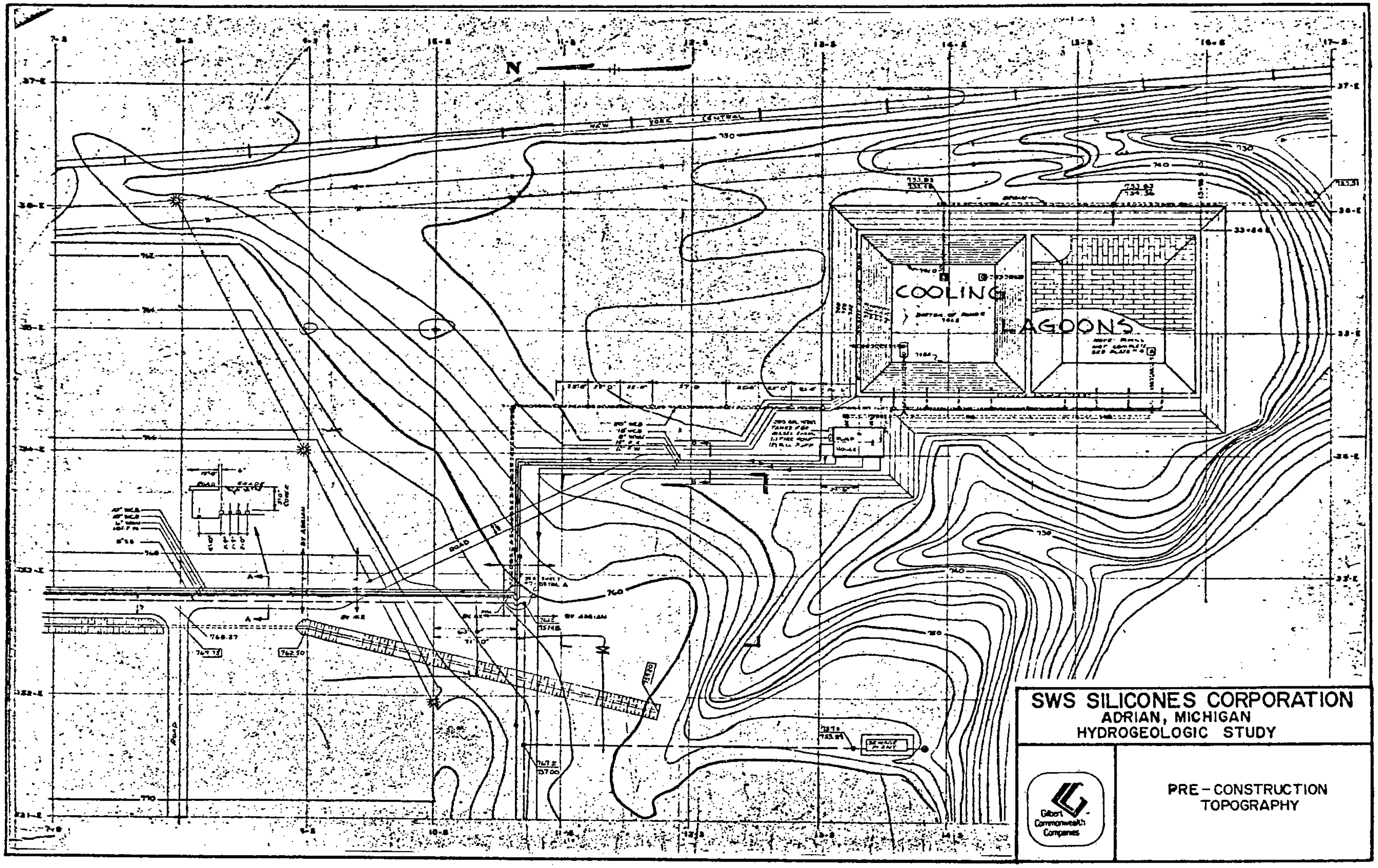

N
NEW YORK CENTRAL
COOLING
LAGOONS
ROAD
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
HYDROGEOLOGIC STUDY
PRE-CONSTRUCTION
TOPOGRAPHY

PLATE-4

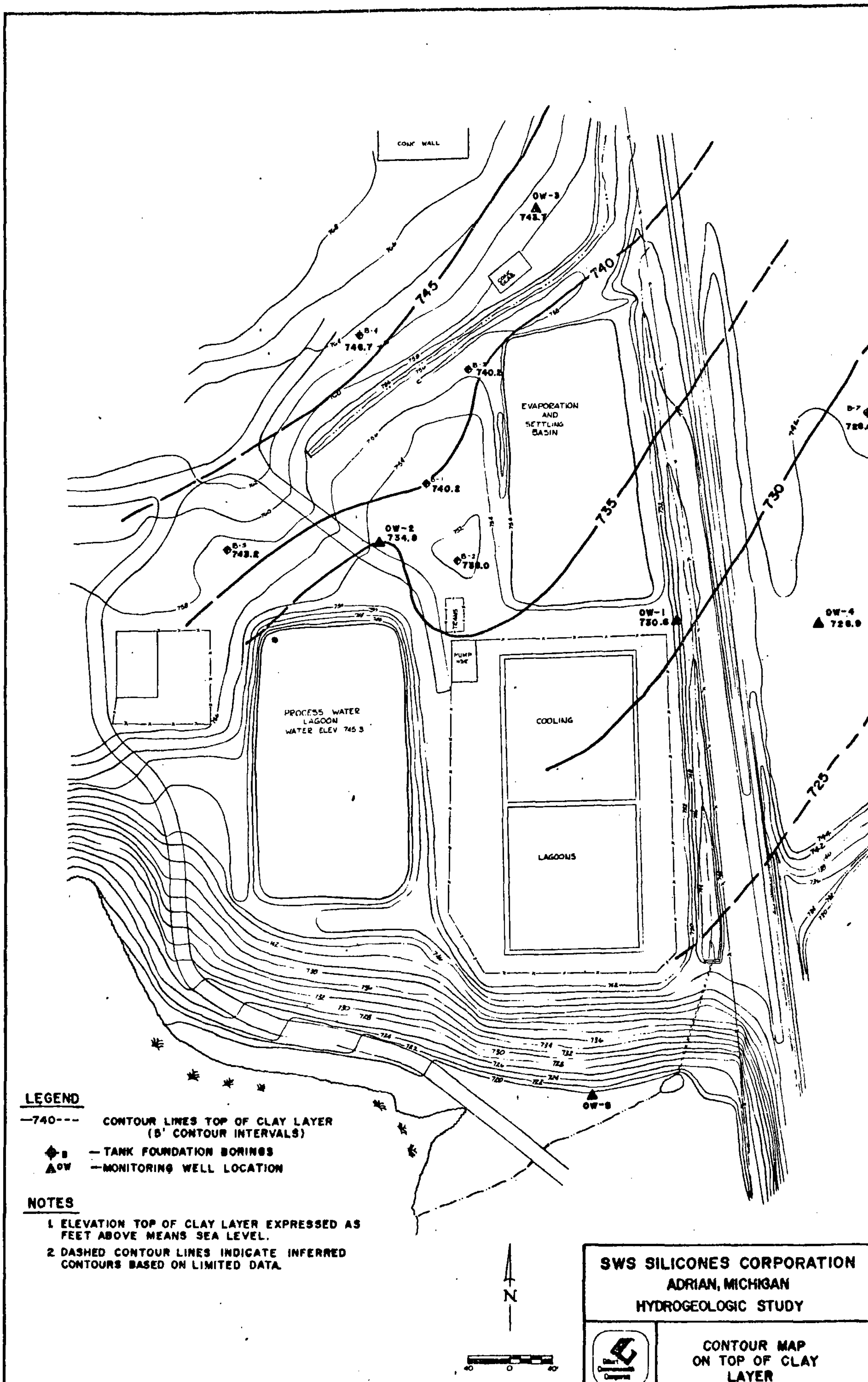
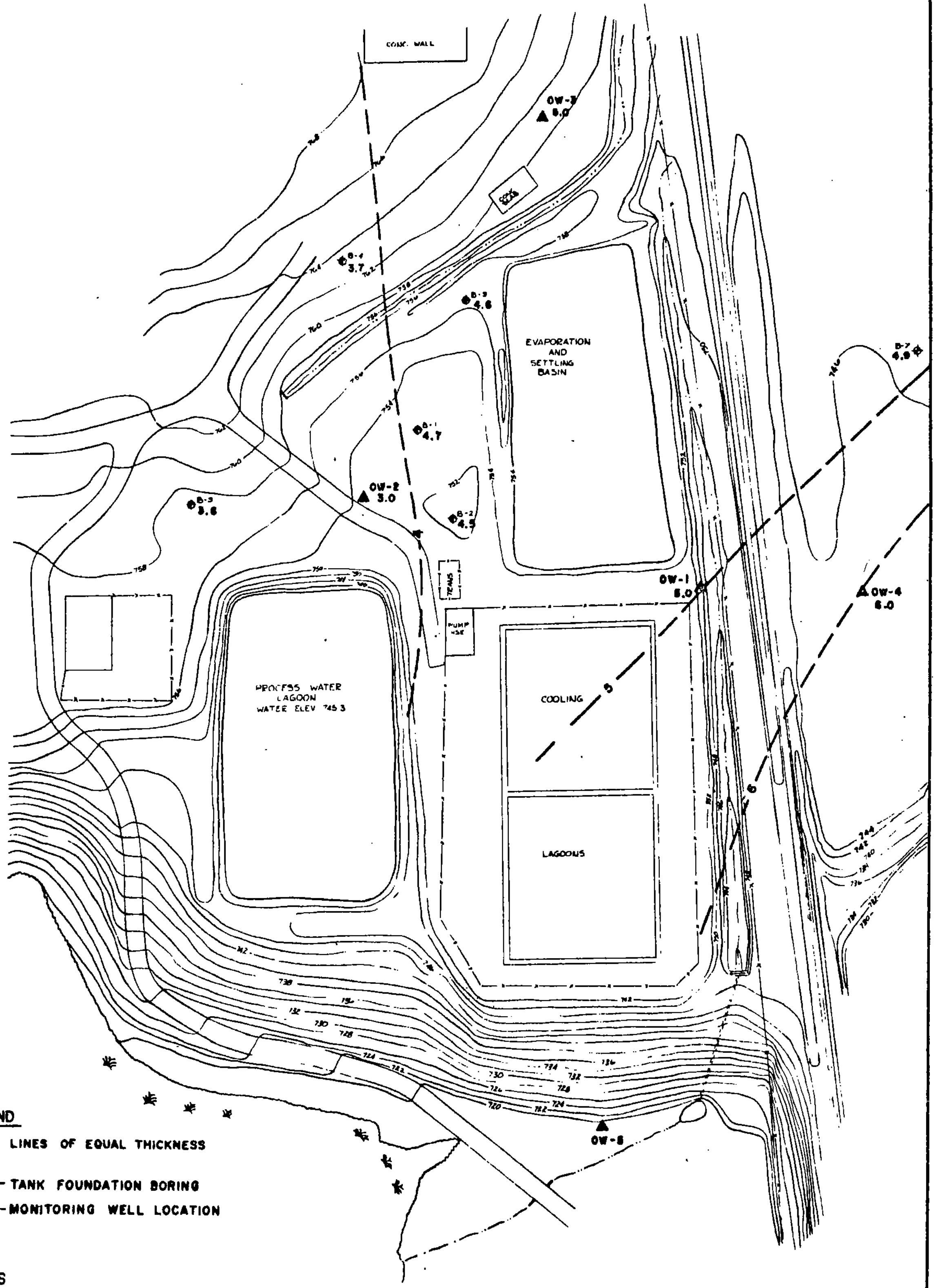

CONC WALL
OW-3 743.7
740
745
735
730
725
B-4 746.7
B-3 740.2
B-1 740.2
B-5 743.2
B-2 738.0
B-7 726.6
OW-2 734.9
OW-1 730.6
OW-4 726.9
OW-5
EVAPORATION AND SETTLING BASIN
PROCESS WATER LAGOON WATER ELEV 745.3
PUMP HSE
COOLING
LAGOONS
LEGEND
—740--- CONTOUR LINES TOP OF CLAY LAYER (5' CONTOUR INTERVALS)
—TANK FOUNDATION BORINGS
—MONITORING WELL LOCATION
NOTES
1. ELEVATION TOP OF CLAY LAYER EXPRESSED AS FEET ABOVE MEANS SEA LEVEL.
2. DASHED CONTOUR LINES INDICATE INFERRED CONTOURS BASED ON LIMITED DATA.
N
40 0 40'
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
HYDROGEOLOGIC STUDY
CONTOUR MAP ON TOP OF CLAY LAYER

PLATE 5



LEGEND

—5— LINES OF EQUAL THICKNESS

◆B — TANK FOUNDATION BORING

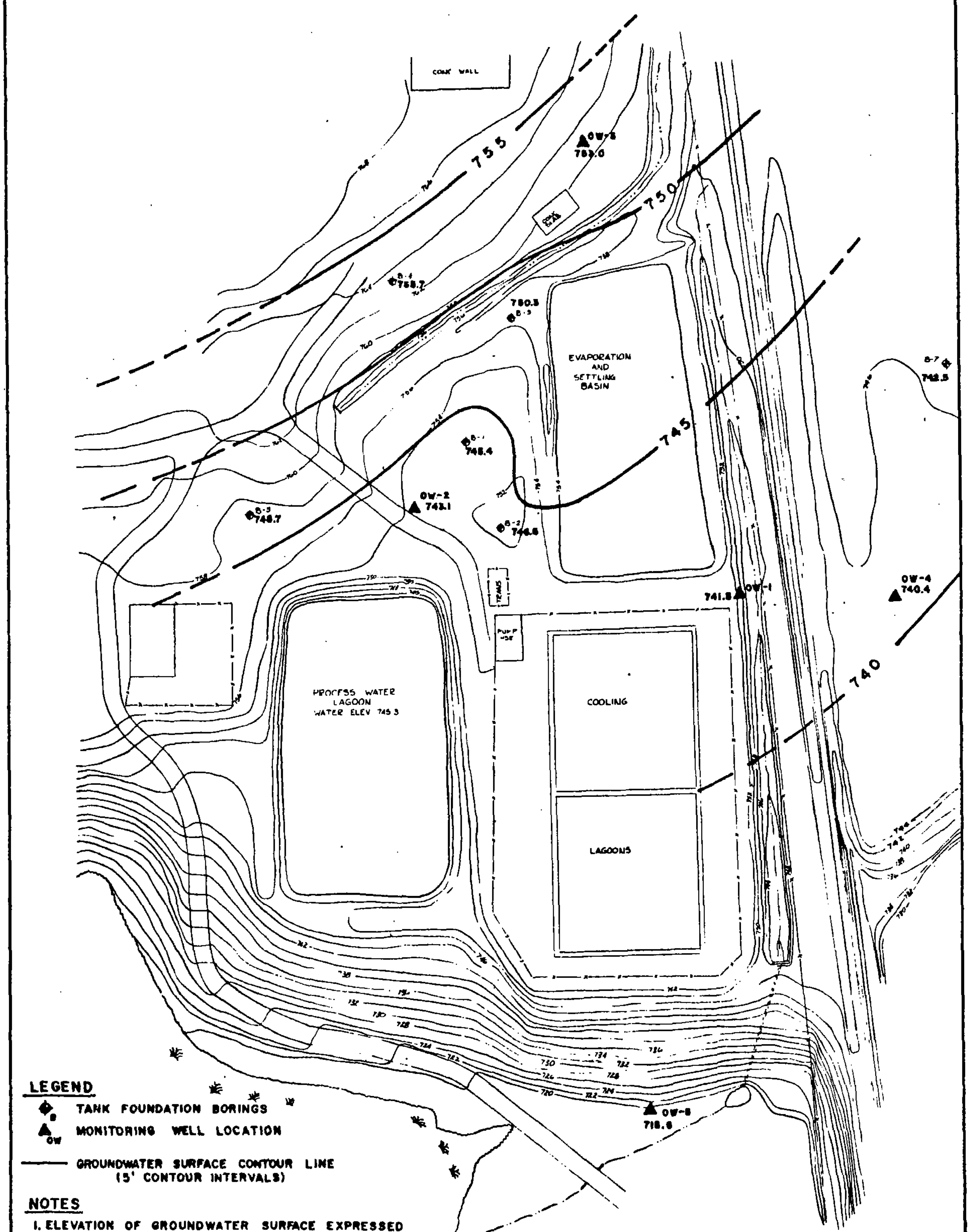
▲OW — MONITORING WELL LOCATION

NOTES

1. THICKNESS OF CLAY LAYER EXPRESSED IN FEET

SWS SILICONES CORPORATION ADRIAN, MICHIGAN HYDROGEOLOGIC STUDY
GENERALIZED ISOPACH OF CLAY LAYER

PLATE 6



LEGEND

- TANK FOUNDATION BORINGS
- MONITORING WELL LOCATION
- GROUNDWATER SURFACE CONTOUR LINE (5' CONTOUR INTERVALS)

NOTES

1. ELEVATION OF GROUNDWATER SURFACE EXPRESSED AS FEET ABOVE MEAN SEA LEVEL.
2. DASHED LINES INDICATE INFERRED CONTOURS BASED ON LIMITED DATA.
3. PROCESS WATER LAGOON IS CLAY LINED WITH TILE DRAIN AT TOP OF CLAY IN NORTHWEST PORTION OF LAGOON; COOLING PONDS HAVE ARTIFICIAL LINER, EVAPORATION-SETTLING POND IS UNLINED.
4. CONTOURS ARE COMPOSITE OF WATERLEVELS RECORDED JUNE 5 AND 6, 1980 FROM TANK FOUNDATION BORINGS AND JULY 1, 1980 FROM MONITORING WELLS. CORRELATION OF WATER LEVEL DATA INDICATES AN APPROXIMATE 2' DROP IN WATER LEVEL BETWEEN RECORDING TIMES.

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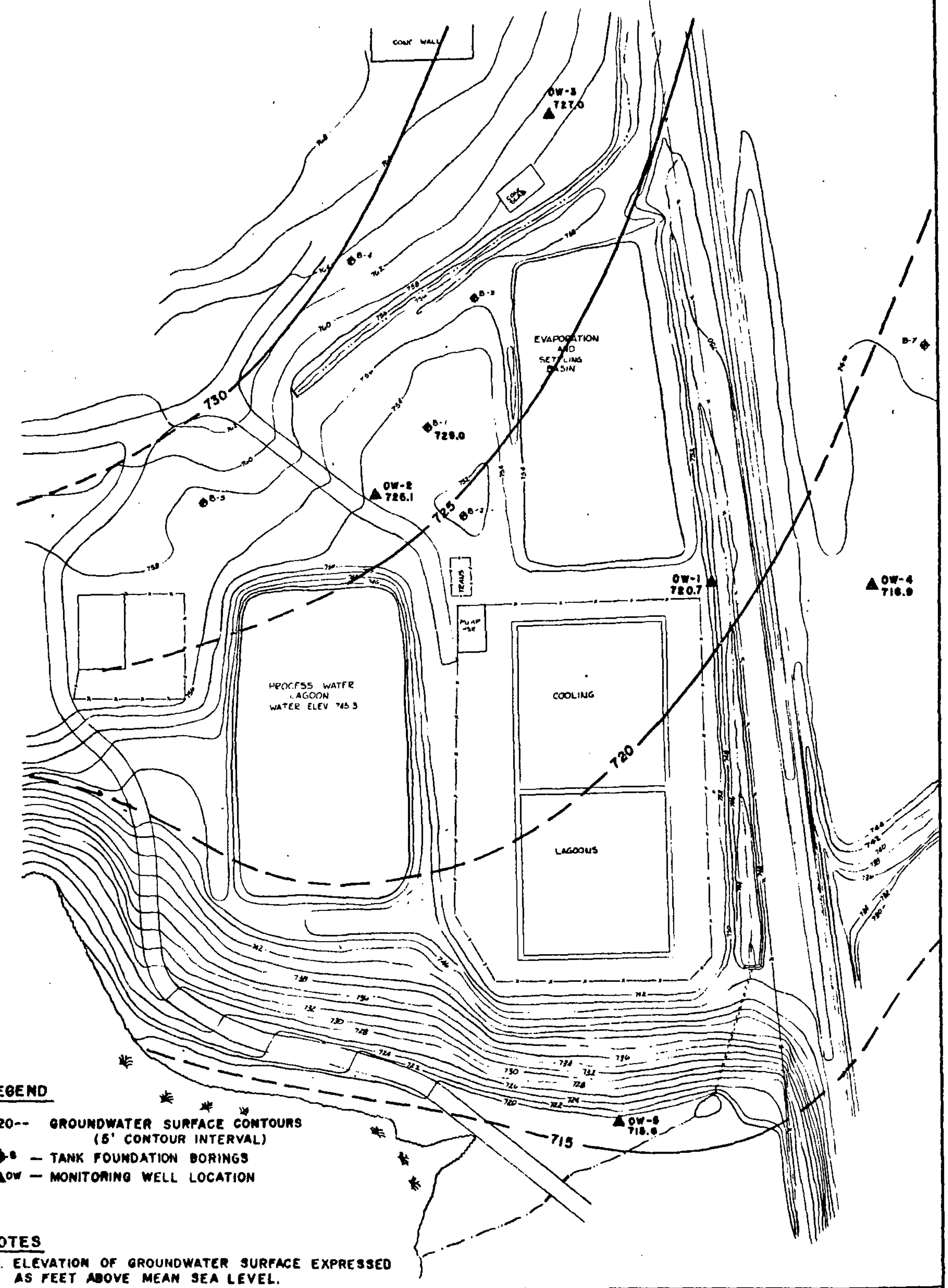
GROUNDWATER SURFACE
PERCHED WATER
TABLE

PLATE 7



LEGEND

—720-- GROUNDWATER SURFACE CONTOURS (5' CONTOUR INTERVAL)

◆B — TANK FOUNDATION BORINGS

▲OW — MONITORING WELL LOCATION

NOTES

1. ELEVATION OF GROUNDWATER SURFACE EXPRESSED AS FEET ABOVE MEAN SEA LEVEL.
2. ELEVATION OF GROUNDWATER SURFACE MEASURED JULY 1, 1980 IN MONITORING WELLS (OW-SERIES) AND JUNE 5, 1980 IN BORING B-1.
3. DASHED CONTOUR LINES INDICATE INFERRED CONTOURS BASED ON LIMITED DATA
4. ELEVATION OF WATER LEVEL FOR B-1 MAY HAVE DROPPED BETWEEN JUNE 5, 1980 WHEN B-1 WAS DRILLED AND JULY 1, 1980 WHEN WATER LEVELS WERE RECORDED IN MONITORING WELLS.

40 0 40

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HYDROGEOLOGIC STUDY

GROUNDWATER SURFACE
NORMAL WATER TABLE

PLATE 8

APPENDIX A

FIELD EXPLORATIONS AND LABORATORY TESTS

FIELD EXPLORATIONS

Seven exploration borings, numbered B-1 to B-7 and five borings for monitoring wells were drilled and sampled at the SWS Silicones Plant using truck-mounted rotary-wash type drilling equipment. The rotary-wash method was used in drilling all borings except B-6 and B-7. Borings B-6 and B-7 were drilled using continuous flight augers. The borings were drilled to depths ranging from 12 to 40 feet. Locations of the borings are shown on Plate 2 - Boring Location Plan.

Relatively undisturbed soil samples were obtained within the clay layer by the use of Shelby tubes hydraulically pushed into the ground. Standard Penetration tests were performed at 2-1/2 to 5 feet intervals. Shelby tube sampling and Standard Penetration tests were performed in accordance with ASTM Methods D1587-74 and D1586-67, respectively.

The field explorations were under the supervision of a qualified CAI soils engineer who classified the soils encountered by visual and textural examination and maintained a continuous and detailed log of each boring. A graphical representation of the boring logs is presented on Plates A-1 to A-12. The soils have been classified in accordance with the Unified Soil Classification System (ASTM D2487-69).

Ground surface elevations and boring locations were determined by CAI personnel using standard surveying procedures. Where possible, the depth to the static water level was measured prior to backfilling of the borehole.

LABORATORY STUDIES

A number of laboratory tests were performed on representative samples obtained from the borings to determine pertinent physical properties of the various soil types encountered. The tests included moisture-density determinations, Atterberg limit tests, unconfined compression tests, laboratory vane shear tests (Torvane), sieve analysis, and consolidation tests. All engineering tests were performed on extruded Shelby tube soil samples. Jar samples from standard penetration tests were used in soil classification tests.

1. <u>Moisture-Density Determinations</u>

   Moisture content determinations were performed in accordance with ASTM D2216-71. Moisture tests were performed on selected samples for correlation purposes. Density determinations were performed only on thin-walled Shelby tube samples. The results of all moisture-density tests are shown to the left of the boring logs.

2. Atterberg Limits

Liquid and plastic limit tests were performed in accordance with ASTM D423-66 and D424-59. These tests were performed for soil classification purposes and have been used to correlate soils strata and engineering properties from empirical relationships. The results of these tests are shown to the left of the boring logs.

3. Particle Size Determinations

Sieve analysis tests were performed on selected soil samples to determine their correct classifications. The tests were performed in accordance with ASTM D422-63. The percentage of fines passing the No. 200 sieve is shown to the left of the boring logs. Gradation curves of the soils are presented on Plates A-13 and 14.

4. Strength Tests

The clay layer was tested to determine its undrained strength properties. Unconfined compression and Torvane shear tests were performed on selected thin-walled tube samples. The unconfined compression tests were performed in accordance with ASTM D2166-66. All test results are reported to the left of the boring logs.

5. Consolidation Test

A consolidation test was performed on a representative sample of the clay layer in accordance with ASTM D2435-70. The consolidation test was performed on the clay in order to assess the compressibility characteristics. Of interest was the Recompression index (C'r), the Compression index (C'c), the Preconsolidation pressure (Pc) and the Coefficient of consolidation (Cv). The consolidation curve with appropriate supporting data is presented on Plate A- 15.

6. Falling Head Permeability Test

A falling head permeability test was performed on representative samples of silt from above the clay layer and below the layer. A head of approximately 6 feet was applied to both samples. Permeability of the specific soils is discussed in the text.

The following plates are attached and complete this appendix.

Plate A-1:	Boring B-1
Plate A-2:	Boring B-2
Plate A-3:	Boring B-3
Plate A-4:	Boring B-4
Plate A-5:	Boring B-5
Plate A-6:	Boring B-6
Plate A-7:	Boring B-7
Plate A-8:	Boring OW-1
Plate A-9:	Boring OW-2
Plate A-10:	Boring OW-3
Plate A-11	Boring OW-4
Plate A-12	Boring OW-5
Plate A-13	Gradation Curves
Plate A-14	Gradation Curves
Plate A-15	Consolidation Test Data

WASTE STORAGE TANK STUDY
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BORING B-1

SURFACE ELEVATION 753.0'
COORDINATE: 1163 S - 3363 E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET
					7.3				5.4	5
					27.6				89.4	10
		U.C.= 2230 TV=2000+			23.1	108.3	90			15
										20
					22.3				72.9	25
										30
					21.7				8.8	35
										40
										45
										50
										55
										60

BLOW COUNT	SYMBOLS	DESCRIPTION
	SP-SM	BROWN FINE TO MEDIUM SAND, TRACE SILT. (FILL)
41, 12		BROWN FINE TO MEDIUM SAND, TRACE TO LITTLE SILT, COARSE SAND NOTED. (DENSE)
5, 12	ML	BROWN SILT, LITTLE FINE SAND. 8.5' TO 10' GRADES WITH SOME FINE SAND. (LOOSE)
8, P	CL	GRAY SILTY CLAY, SILT LENSES NOTED IN LOWER PART OF CLAY. (MEDIUM STIFF)
76	ML	LIGHT BROWN SILT, SOME FINE SAND NOTED. (VERY DENSE)
43		(DENSE)
43	SP-SM	BROWN FINE SAND, TRACE SILT.
34		
63		GRADES TO GRAY (VERY DENSE)
		BORING TERMINATED AT 40' ON 6-5-80
		WATER ENCOUNTERED AT 7.6' AND 24'

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

WASTE STORAGE TANK STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING B-2

SURFACE ELEVATION 751.5'
COORDINATE 1288S-3450E

ELEV. IN FEET	OTHER TESTS	STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET
										0–5
					11.2				14.5	5–10
										10–15
					17.3					15–20
					25.0				73.1	20–25
										25–30
										30–35
										35–40
										40–45
										45–50
										50–55
										55–60

BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
43	⊠	SM	BROWN FINE TO MEDIUM SAND, SOME SILT. (FILL) (DENSE)
31, 10	⊠, ⊠	SM	BROWN FINE TO COARSE SAND, LITTLE SILT. (MEDIUM DENSE)
12, 18	⊠, ⊠	ML	BROWN SILT, SOME FINE SAND.
P, P	□, □	CL	GRAY SILTY CLAY. (MEDIUM STIFF)
43, 41	⊠, ⊠	ML	GRAY-BROWN SILT, SOME FINE SAND. (DENSE)
			BORING TERMINATED AT 25' ON 6-5-80
			WATER ENCOUNTERED AT 5.0' AND 24'

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

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WASTE STORAGE TANK STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING B-3

SURFACE ELEVATION 756.3'
COORDINATE 1062 S - 3428E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
					10.5					5	5	⊠	SP-SM	BROWN FINE TO MEDIUM SAND, COARSE SAND NOTED, SOME SILT. (TOP 4.4' IS FILL) (LOOSE)
											12	⊠	SP-SM	(MEDIUM DENSE)
					23.0				90	10	15	⊠	ML	LIGHT BROWN SILT, TRACE FINE SAND. (MEDIUM DENSE)
											20	⊠		GRADES TO GRAY
					23.9				91.5	15	17	⊠		
		PN:3500			28.2	98.8					10	⊠	CL	GRAY SILTY CLAY, LITTLE FINE SAND. (MEDIUM STIFF)
											P			
										20	P			
					20.1				97.3		38	⊠	ML	(DENSE) BROWN SILT SOME FINE SAND
										25	89	⊠		(VERY DENSE)

BORING TERMINATED AT 25' ON 6-6-80
WATER ENCOUNTERED AT 6.8'

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

LEGEND

⊠ — STANDARD PENETRATION TEST
■ — UNDISTURBED SOIL SAMPLE
◪ — DISTURBED SOIL SAMPLE
□ — LOST SOIL SAMPLE
CR — CORE RUN NO.
22 — BLOWS PER FOOT
P — HYDRAULICALLY PUSHED
TV — TORVANE TEST
UC — UNCONFINED COMPRESSION TEST
Gs — SPECIFIC GRAVITY
C — CONSOLIDATION TEST
PN — PENETROMETER

LOG OF BORING

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WASTE STORAGE TANK STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING B-4

SURFACE ELEVATION 763.7'
COORDINATE 1033 S -3374 E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
					13.6				14		8	⊠	SM	BROWN FINE TO MEDIUM SAND, TRACE COARSE SAND AND SILT. (LOOSE), (FILL)
					25.3				96.4	5	7	⊠	ML	BROWN SILT, TRACE FINE SAND. (MEDIUM DENSE)
					28.6						7	⊠		
										10	14	⊠		
					25.4						19	⊠		
										15	34	⊠		(DENSE)
		PN:5600 UC:1770 TV:2000+	29	12	20.1	112.7					P	■	CL	GRAY SILTY CLAY. (STIFF)
		PN:4600								20	22	⊠	ML	GRAY-BROWN SILT, SOME FINE SAND. (VERY DENSE)
					16.5					25	143	⊠		BORING TERMINATED AT 25' ON 6-6-80
										30				WATER ENCOUNTERED AT 8.0'
										35				
										40				
										45				
										50				
										55				
										60				

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

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WASTE STORAGE TANK STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING B-5

SURFACE ELEVATION 756.9'
COORDINATE 1221 S - 3183 E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET
					13.0					5–10
					34.4					10–15
					25.2					10–15
		TV:2000 +	35.0	16.9	26.4	104.2				15
					17.8					15–20
									70.7	25

BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
8	⊠	SP SM	BROWN FINE TO MEDIUM SAND, TRACE COARSE SAND, SOME SILT. (FILL)
6	⊠	SP. SM	BROWN FINE TO MEDIUM SAND, TRACE SILT. (LOOSE)
9	⊠	ML	GRAY-BROWN SILT, TRACE FINE SAND. (VERY LOOSE)
1	⊠		
12	⊠		(MEDIUM DENSE)
P	■	CL	GRAY SILTY CLAY. (STIFF)
P	■		
57	⊠	ML	BROWN SILT, SOME FINE SAND. (VERY DENSE)
46	⊠		

BORING TERMINATED AT 25' ON 6-6-80

WATER ENCOUNTERED AT 8.2'

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

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BORING B-6

SURFACE ELEVATION 778'
COORDINATE 775 S - 2460 E
(APPROXIMATE)

ELEV. IN FEET	OTHER TESTS	STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	R Q D		DEEP IN FEET	BLOW COUNT	SAMPLES

DEEP IN FEET: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

SYMBOLS	DESCRIPTION
CL	BROWN SANDY CLAY, COARSE SAND NOTED.
ML	BROWN SANDY SILT, TRACE CLAY, SATURATED.
SC	BROWN CLAYEY FINE TO MEDIUM SAND, LITTLE COARSE SAND, MOIST.
SM	BROWN SILTY FINE SAND, MOIST.

BORING TERMINATED AT 12' ON 6-6-80
WATER ENCOUNTERED AT 3'

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◩ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

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WASTE STORAGE TANK STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING B-7

SURFACE ELEVATION 746'
COORDINATE 1175 S - 3775E
(APPROXIMATE)

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
									0–6	11	☒	SW	BROWN MEDIUM TO COARSE SAND, TRACE FINE GRAVEL. (MEDIUM DENSE)
									6–15.5	16, 11	☒ ☒	ML	BROWN SILT, TRACE FINE SAND. 9.5' GRADES TO GRAY
		PN 4000 PN 7800			23.9	108.2			15.5–20.5	15, 16, 22	☒ ☒ ☒	CL	GRAY SILTY CLAY. (STIFF)
									20.5–21.5	53	☒	ML	BROWN SILT, SOME FINE SAND. (VERY DENSE)
													BORING TERMINATED AT 21.5' ON 6-6-80
													WATER ENCOUNTERED AT 3.5'

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

LEGEND

- ☒ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◩ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

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HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-1

SURFACE ELEVATION 752.1
COORDINATE 1298 S – 3612E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
										5	10	⊠	SM	Brown fine to medium SAND, some silt. (Fill) (Medium Dense)
									8.6	10	15	⊠	SW SM	Varicolored fine to coarse SAND and fine gravel, trace silt.
										15	36	⊠	ML	Light gray-brown SILT, some fine sand. (Medium Dense)
									87.2		23	⊠		
										20	46	⊠		Grades to gray, thin clay seams noted.
											17	⊠		
			28.4	11.6	22.4				90.1	25	16	⊠	CL	Gray CLAY, trace silt, coarse sand noted. (Stiff)
											15	⊠		
									68.8	30	49	⊠	ML	Gray SILT, some fine sand. (Very Dense)
										35	58	⊠		
									6.4	40	64	⊠	SP SM	Brown fine SAND, trace silt. (Very Dense)
														Boring terminated at 40' on 6/20/80. Water level encountered at 10.8' and 31.4'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 40.0 feet; gravel packed to a depth of 27.5 feet; bentonite seal from a depth of 24.5 to 27.5 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 19.3 feet; gravel packed to a depth of 5.0 feet; bentonite seal from a depth of 3.0 to 5.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR- — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

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HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-2

SURFACE ELEVATION 753.8'
COORDINATE 1210S-3336E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	DEEP IN FEET
					26.0				15–20
					23.0				15–20
		PN-1800							20–25

DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
0–5	2	⊠	SM	Brown fine to medium SAND, some silt, trace coarse sand. (Fill) (Loose)
5–11	10	⊠	SM	Brown fine to medium SAND, some silt, moist.
11–19	23, 23	⊠, ⊠	ML	Brown SILT, trace fine sand. (Medium Dense)
19–22	13	⊠	CL	Gray CLAY. (Stiff)
22–29	29, 30	⊠, ⊠	ML	Tan-brown SILT, some fine sand. (Dense)
29–40	43, 51, 105	⊠, ⊠, ⊠	SM	Tan-brown fine SAND, some silt, grades to gray. (Grades Very Dense) Clayballs noted, grades coarser.

Boring terminated at 40' on 6/23/80.
Water level encountered at 10.7' and 27.7'.

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 35.5 feet; gravel packed to a depth of 22.0 feet; bentonite seal from a depth of 19.0 to 22.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 19.5 feet; gravel packed to a depth of 7.0 feet; bentonite seal from a depth of 4.0 to 7.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-3

SURFACE ELEVATION 760.7
COORDINATE 897S - 3512E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD		DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
									38.6	5	9	⊠	SM	Brown fine to coarse SAND and SILT. (Fill) (Loose)
										10	10	⊠	ML	Brown SILT, some fine sand.
									74.7	15	32	⊠		Grades to gray. (Graded Dense)
		PN-2750	30.4	13.0	19.2					20	17	⊠	CL	Gray CLAY. (Stiff) Grades with silt seams.
		PN-3700									29	⊠		Grades with silt seams.
									71.2	25	72	⊠	ML	Gray SILT, some fine sand. (Very Dense)
										30	37	⊠		(Grades Dense) Grades to tan.
										35	60	⊠	SM	Brown fine SAND, trace silt. (Very Dense)
										40	78	⊠		Boring terminated at 40.5' on 6/25/80. Water level encountered at 7.7' and 33.7'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 40.0 feet; gravel packed to a depth of 22.0 feet; bentonite seal from a depth of 19.0 to 22.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 17.0 feet; gravel packed to a depth of 6.0 feet; bentonite seal from a depth of 3.0 to 6.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- ☐ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-4

SURFACE ELEVATION 744.9'
COORDINATE 1276 S-3762E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD		DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
													SW	Brown fine to coarse SAND. (Medium Dense)
									2.4	5	12	⊠		
										10	27	⊠	ML	Tan SILT, trace fine sand. (Medium Dense)
									99.0	15	18	⊠		
											21	⊠		Grades to gray.
										20	12	⊠	CL	Gray CLAY. (Stiff)
		PN-2250	31.6	11.7	23.0						14	⊠		
										25	13	⊠		
									61.6	30	47	⊠	ML	Gray SILT, some fine sand. (Dense)
										35	69	⊠	SM	Gray fine SAND, trace silt. (Very Dense)
									6.7	40	62	⊠		Boring terminated at 40' on 6/26/80. Water level encountered at 4.5' and 28.0'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 37.0 feet; gravel packed to a depth of 24.0 feet; bentonite seal from a depth of 21.0 to 24.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 13.5 feet; gravel packed to a depth of 3.0 feet; bentonite seal from a depth of 1.0 to 3.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- ☐ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-5

SURFACE ELEVATION 719.6
COORDINATE 1532 S - 3528E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
												SM	Gray fine to coarse SAND, some silt and clay.
									5	15	⊠	SW	Tan fine to medium SAND, trace coarse sand and silt.
									10	2	⊠	ML · CL	Dark gray to black clayey SILT, trace fine sand, organic material and coarse sand noted. (Loose)
					21.7				15	8	⊠	SC	Gray fine SAND, some clay
													Boring terminated at 16' on 6/24/80 Water level encountered at 4.5'
									20				
									25				
									30				
									35				
									40				
									45				
									50				
									55				
									60				

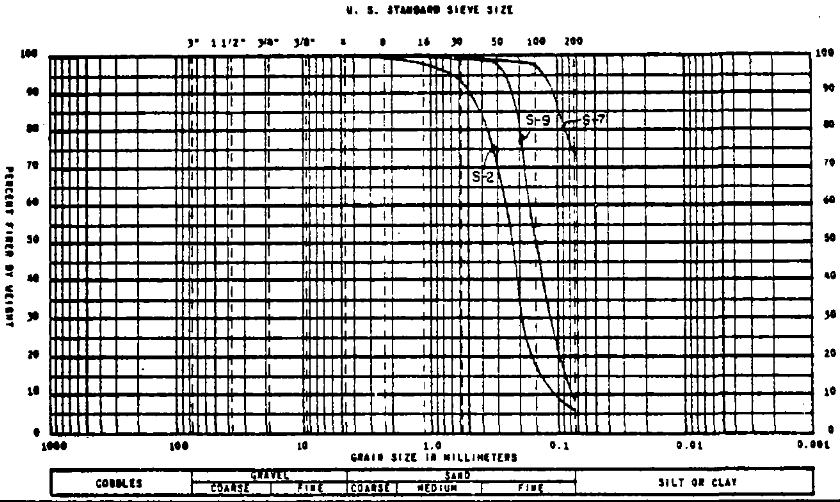
Monitoring well was installed with a 10-foot long preslotted screen as the bottom section. The well had the screen tip at a depth of 15.0 feet; gravel packed to a depth of 4.0 feet; bentonite seal from a depth of 2.5 to 4.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

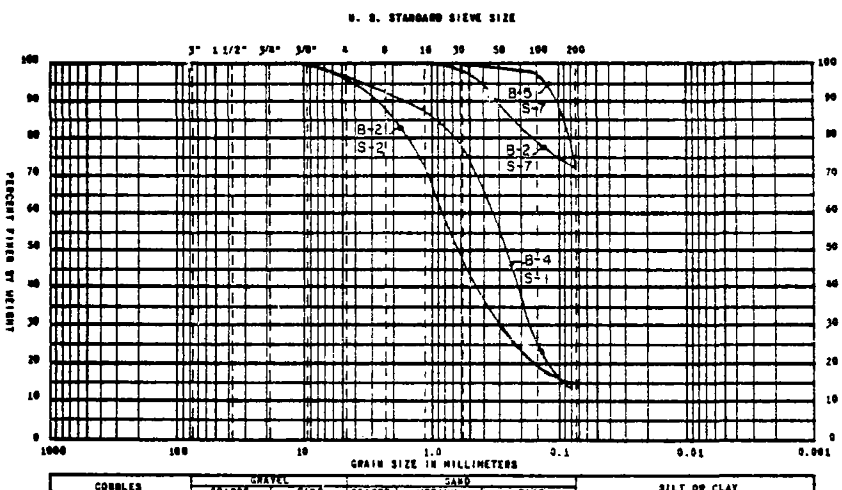
- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- ☐ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B-1	5-6.5 (S-2)	SP-SM	FINE-MEDIUM SAND				
B-1	23.5-25 (S-7)	ML	LIGHT BROWN SILT				
B-1	33.5-35 (S-9)	SP-SM	BROWN FINE SAND				



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B-2	5-6.5 (S-2)	SM	SILTY FINE-COARSE SAND				
B-2	20-21.5 (S-7)	ML	GRAY-BROWN SILT				
B-4	2.5-4 (S-1)	SM	SILTY FINE MEDIUM SAND				
B-5	23.5-25 (S-7)	ML	BROWN SILT				

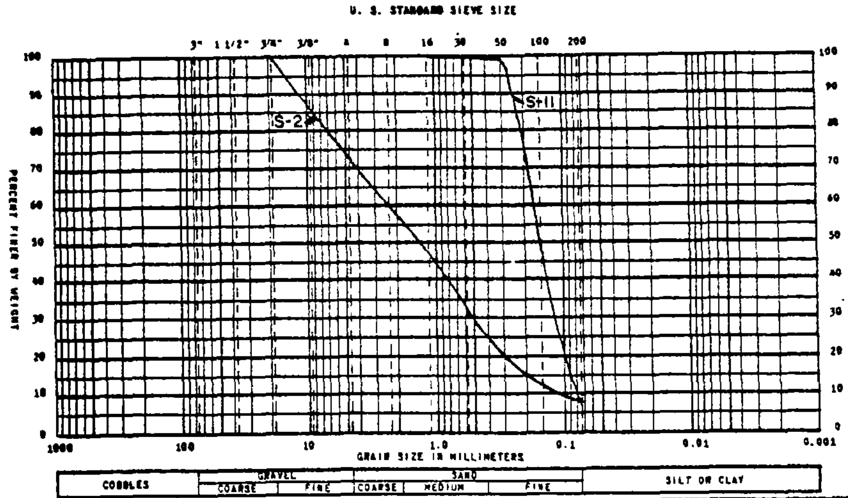
SWS SILICONES CORPORATION

ADRIAN, MICHIGAN

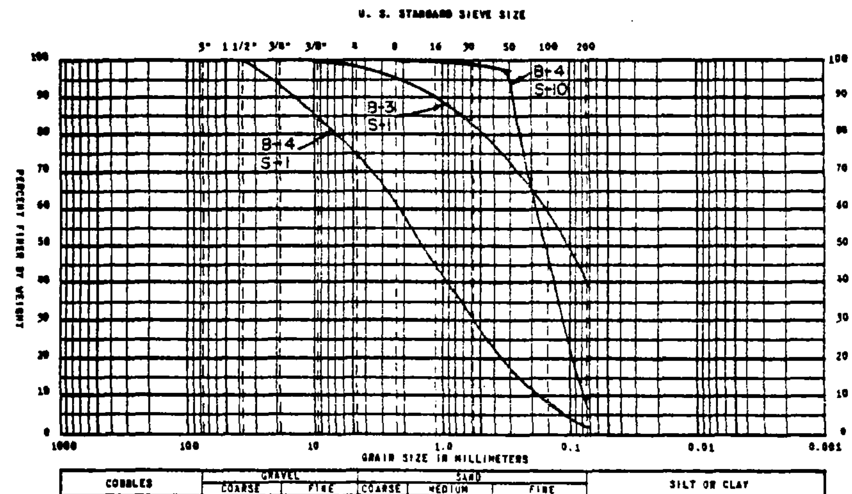
HYDROGEOLOGIC STUDY

Gilbert Commonwealth Companies

GRADATION CURVES



BORING	DEPTH		CLASSIFICATION	LL	PL	PI
B-1	8.5-10' (S-2)	SP-SW	FINE-COARSE GRAVELLY SAND			
B-1	38.5-40(S-11)	SP-SM	FINE SAND			



BORING	DEPTH		CLASSIFICATION	LL	PL	PI
B-3	3.5-5' (S-1)	SM	SILTY FINE-COARSE SAND			
B-4	3.5'-5' (S-1)	SW	FINE-COARSE GRAVELLY SAND			
B-4	38.5-40(S-10)	SP-SM	FINE SAND			

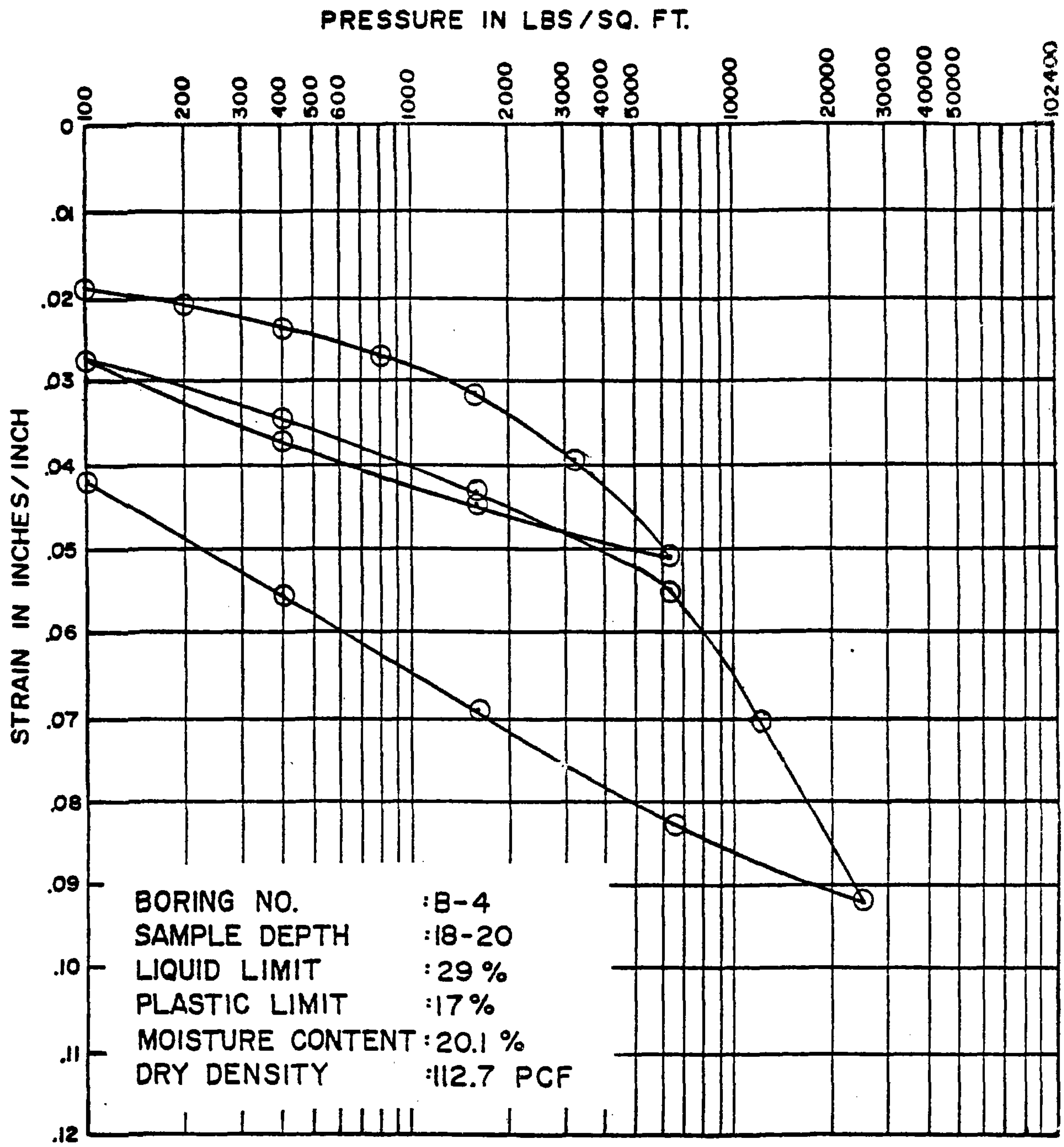
SWS SILICONES CORPORATION

ADRIAN, MICHIGAN

HYDROGEOLOGIC STUDY

Gilbert Commonwealth Companies

GRADATION CURVES



CONSOLIDATION TEST DATA

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert/Commonwealth
ENGINEERS/CONSULTANTS Reading, PA/Jackson, MI

APPENDIX B

PROCEDURES FOR INSTALLATION OF MONITORING WELLS FOR SWS SILICONES - ADRIAN, MICHIGAN

I. GENERAL

A. Monitoring wells will be installed at the locations as specified on Plate 2. The depth at which the monitoring well is installed is dependent on the depth to the water table.

B. The use of bentonite drilling mud or "revert" in these borings will not be permitted unless approved by engineer (CAI).

C. Due to the type and quality of water sampling to be performed from these wells, no PVC glue will be permitted to be introduced into the well which has cured for less than 24 hours.

D. The top of the observation wells shall be 3 feet above the existing ground, be clearly marked with the monitoring well number, and supplied with a vented cap.

E. The bottom of the monitoring well shall be sealed with a cap.

F. Installation of monitoring wells below the first clay layer requires special drilling procedures.

G. Plate B-1 shows typical well installations.

II. MATERIALS

A. The monitoring wells shall be constructed using 2-inch diameter Schedule 80 rigid PVC pipe, threaded couplings, caps, and the appropriate cement.

B. Screens shall consist of 10-foot long preslotted PVC sections. Number 10 slot size shall be used unless substitutes are approved by SWS.

C. The gravel pack shall consist of washed sand, gravel, or a mixture of sand and gravel such that 90 percent will be retained by the slot size.

D. Bentonite in pellet form and equivalent to naturally occurring Wyoming bentonite whall be used for the bentonite seal above the gravel pack.

III. PROCEDURE FOR DRILLING

A. Borings shall be made with heavy duty rotary drilling equipment of a size and type designed to drill holes of 4 to 6 inches in diameter. Drilling units shall be equipped with hydraulic feed. All drilling shall be accomplished using "A" size or larger drilling rods. Borings will be held open either by circulating a drilling fluid approved by Stauffer Chemical Company or by the use of casing.

B. Standard Penetration Tests performed at 2-1/2 to 5 feet intervals or at change in stratigraphy will be used to determine physical properties, stratigraphy, and thickness of the various soil strata encountered.

C. Special Drilling Procedures: Borings penetrating the upper confining layer of clay require casing to be set into the clay prior to penetration of the layer. The existing drilling fluid will be flushed from the casing and a new, clean drilling fluid used for advancing the hole. Disposal of the drilling fluid shall be as specified by SWS.

D. Each boring shall be advanced using flight augers, tricone, fish tail or other bits as approved by the engineer (CAI), hollow stem augers will not be permitted for installing monitoring wells.

IV. PROCEDURE FOR INSTALLING MONITORING WELLS

A. After drilling is completed, the casing will be washed out leaving it filled with relatively clean water. If no casing is used, the drilling fluid will be thinned out but left thick enough for the hole to stand open.

B. The well pipe will be lowered to a depth such that the top 10 feet of the water table will be monitored. The depth to the bottom of the well pipe and location of the screen in relation to the bottom will be recorded.

C. The gravel pack will be poured into the hole while at the same time pulling the casing (if used). The casing will be pulled up to within 1 foot of the top of the gravel pack.

D. After completing the installation of the gravel pack to the specified depth (see Section IV F) an approximately 3-foot thick bentonite seal will be installed to prevent migration of water from overlying strata into the screened section of the monitoring well. Casing will be pulled as required to obtain an effective bentonite seal.

E. A cement/bentonite grout will be installed from the bentonite seal to the ground surface. At the ground surface a 2-foot diameter cement cap, mounded to provide drainage radially away from the PVC pipe, anchored at least 6 inches into the ground surface at its perimeter will be installed. Casing will be pulled while maintaining a suitable head of grout to obtain a continuous grout seal from the bentonite seal to the ground surface.

F. Location of Bentonite Seal

1. Monitoring wells extending below the upper confining clay layer will be gravel packed to the base of the clay; the bentonite seal will be predominantly within the clay layer; cement/ bentonite grout will extend from the upper part of the clay layer to the ground surface.

2. Monitoring wells seated above the clay layer will be gravel packed to 1 foot above the top of the screened section or as directed by the engineer (CAI); the bentonite seal will be installed above the gravel pack and the cement/ bentonite grout above the bentonite seal to the ground surface.

G. Cleaning out of monitoring wells

1. Due to the nature of the possible contaminants, pumping or bailing will be used to clean out the piezometers after installation. If significant sediment is present, an air hose should be lowered to the bottom of the monitoring well to blow the sediment out.

2. After installation of the monitoring well or blowing out of sediment, bailing or pumping should be performed approximately three times a day for 1 week to remove drilling fluid or aerated water.

H. Monitoring wells will be supplied with vented caps to exclude surface water or sediment contamination.

The following plate is attached and completes this appendix.

Plate B-1 - Typical Monitoring Well Installation

CP → Babcock → Ross → file

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

RECEIVED
DEC 01 1980
WQC COMPLIANCE

December 1, 1980

TO: Robert Babcock, Surface Water Compliance Section

FROM: Larry Fink, Office of Toxic Materials Control LEF

RECEIVED
DEC 01 1980
WQC COMPLIANCE

SUBJECT: Hydrogeological Survey and Lagoon Closure
SWS Silicones Corp., Adrian, Michigan

Based on the results of the Phase I hydrogeological survey conducted by SWS Silicones according to a protocol approved by William Iverson, Groundwater Compliance and Special Studies Section, it has been established that the evaporation lagoon seeped, resulting in the contamination of water beneath the pond with methylchloroform (1,1,1-trichloroethane). It is also likely that soils underlying the lagoon have become contaminated with substances historically discharged to the lagoon. To determine the identity and concentration of toxic pollutants potentially contaminating soils beneath the lagoon, we are recommending that samples of underlying soils be obtained; a leachate test performed on the soils according to RCRA protocols; and the leachate analyzed for the Section 307(a) toxic pollutants, the Critical Material styrene, and the halogenated fire retardants Dechlorane 5-10 and 604.

The proposed method of closure does not appear to meet the requirements of either Act 64 or RCRA. A determination should be made by the Office of Hazardous Waste Management as to whether the sludge in the lagoon is hazardous according to any Act 64 or RCRA criteria. At a minimum, it would appear appropriate to require some sort of underdrainage collection system and a monitoring well to establish that the lagoon is no longer a source of groundwater contamination, if the sludges are to be left on-site and the lagoon capped.

Should you have any questions, feel free to contact me.

LF/vls
cc: J. Grant/OTMC Files
V. Harris
R. Schrameck, District 1
W. Iversen
C. Bek

Stauffer CHEMICALS INTER-OFFICE CORRESPONDENCE

ORIGINATING OFFICE Westport

TO (LOCATION) Adrian

FROM B.S. McClellan
Sr. Hydrogeologist

DATE 12/20/82

ATTENTION G.C. Philbrook

SUBJECT Estimate of Mass Loading, Phase II Hydrogeologic Investigation, Evaporation and Settling Basin, Adrian

COPY TO J. Calamungi
G.L. Ford
D. McGrade
T.J. Sayers

This report presents an estimate of mass loading from the basin to the river. This estimate is based on my review of the information obtained during the Phase II Hydrogeologic Investigative work performed in regards to the now closed Evaporation and Settling Basin. Specifically I have reviewed two reports by the outside contractor Gilbert/Commonwealth.

1. Report No. 1 - Permeability Testing of OW-Series Observation Wells For SWS Silicones Corporation

2. Report No. 2 - Ground-Water Flow Beneath the Sealed Evaporation and Settling Basin at SWS Silicones Corporation, Adrian, Michigan

Also reviewed were the results of chemical analysis performed by SWS Silicones Corporation on samples collected from the nine observation wells on June 9, 1982, July 21, 1982 and August 11, 1982.

The purposes of this work has been to obtain the information needed to estimate the mass loading (in pounds per unit time) to the river from the basin area via ground-water discharge from the "Perched and Near Surface Aquifers." Based on the work conducted the estimated cumulative total mass loading for the chlorinated organic chemicals analyzed was 0.502 pounds per day from the "Perched Aquifer" and 0.003 pounds per day from the "Near Surface Aquifer." Ground-water in the "Perched Aquifer" (shallow) discharges along the upland slope to the floodplain swampy area and from the "Near Surface Aquifer" (deeper) to the floodplain swampy area and the River Raisin.

Discussion of Methods Used

Ground-Water Discharge Rate: The ground-water discharge rate was determined by Gilbert/Commonwealth for both the "Perched Aquifer and Near Surface Aquifer." In order to accomplish this it was necessary to determine the in-situ permeability of the soil contained in each saturated zone and construct a structural/hydrogeologic model of the site from which the dimensions of ground-water flow could be determined. The work performed and conclusion reached are described at depth in Reports No. 1 and No. 2. In Report No. 2 Gilbert/Commonwealth has presented a discharge rate of 3359 gpd for the "Perched Aquifer" and 2558 gpd for the "Near Surface Aquifer." These discharge rates represent the volume of ground water per unit time that will pass through a cross-sectional area situated downgradient of the basin and are representative of flow in the aquifers beneath the basin.

Chemical Analysis: Ground-water samples from the existing OW-Series wells were analyzed by SWS Silicones for the proposed list of chemicals. Samples were collected on June 9, 1982, July 21, 1982 and August 11, 1982. Using the analytical results from wells 1S, 1D, 4S and 4D (S-perched aquifer and D-near surface aquifer) an average concentration for each chemical in ground-water downgradient from the basin in each aquifer was obtained. Table 1 shows the actual analytical results for each compound, on each date sampled, for the downgradient wells and the average concentration obtained.

TABLE 1

Perched Aquifer

Chemical - mg/L	Well No./Date Sample 1S 6/9	1S 7/21	1S 8/11	4S 6/9	4S 7/21	4S 8/11	Average Concentration Mg/L
TOC	30	900	1000	20	34	360	390.7
Hydrolyzable (Ionic or Non-Organic) Chlorides	950	1600	2157 ✓	1280	1390	1978	1559.2
1,1,1-Trichloroethane	3.7	5.5	6.9 ✓	3.0	2.5	3.6	4.2
1,1-Dichloroethane	17.0	28.0	36.0 ✓	N.D.	0.4	0.35	13.6
t-1,2-dichloroethylene	N.D.	N.D.	N.D.	0.8	0.03	0.03	0.14
Di-n-butyl phthalate	$\leq$ 0.025	--	--	N.D.	--	--	0.013

TABLE 1 - (Continued)

Near Surface Aquifer

Chemical - mg/L	Well No./Date Sampled 1D 6/9	1D 7/21	1D 8/11	4D 6/9	4D 7/21	4D 8/11	Average Concentration mg/L
TOC	13	--	100	8	8	11	28.0
Hydrolyzable (Ionic or Non-Organic) Chlorides	855	--	1180	273	235	249	558.4
1,1,-Trichloroethane	0.13	--	0.12	0.08	0.06	0.18	0.11
1,1-Dichloroethane	N.D.	--	N.D.	N.D.	N.D.	N.D.	N.D.
t-1,2-Dichloroethylene	N.D.	--	N.D.	0.04	0.05	0.16	0.05
Di-n-butyl phthalate	N.D.	--	--	N.D.	--	--	N.D.

NO

Mass Loading Determination: Using the average concentration for each compound (mg/L) in each aquifer and the discharge rate for each aquifer (Liters/day) an estimate of the mass loading for each compound (pounds per day) in each aquifer was obtained. The results of this determination are presented in Table 2 along with the cumulative totals for chlorinated organics. It is important to note that in making this determination no consideration was given to the attenuative capabilities of the water bearing soils or the hydrolytic stability of the compounds involved. Therefore, the results presented here should be viewed as a worst case situation and the actual amounts of the observed compound reaching the discharge areas could be significantly less.

TABLE 2

Mass Loading Determination Lb./day

Compound	Perched (Shallow) Aquifer	Near Surface (Deeper) Aquifer
TOC	10.9	0.6
Hydrolyzable (Ionic or Non-Organic) Chlorides	43.6	11.9
1,1,1-Trichloro-ethane	0.118	0.002
1,1-Dichloro-ethane	0.380	N.D.
t-1,2-Dichloro-ethylene	0.004	0.001
Di-n-butyl Phthalate	< 0.001	N.D.
Chlorinated Organics Cumulative Totals	0.502	0.003

Conclusions

1) I believe that the representation of hydrogeologic conditions presented by Gilbert/Commonwealth are reasonably accurate. Furthermore, because of the relatively high permeability values used for the type of materials described and the recent elimination of the Evaporation and Settling Basin as a source of recharge, I believe that the ground-water discharge rates presented are on the high side. Based on this I do not predict significantly higher values for discharge than those used here.

2) Given that the Evaporation and Settling Basin is now closed and caped the mass loading determinations presented here should be considered a high point. The elimination of the basin as a potential source of recharge to the "Perched Aquifer" should result in a reduction of mass loading values presented here.

3) When considering the mass loading values presented here it is important to keep in mind that this discharge does not occur from a point source but is spread out over a significant area as shown on Figure 5 and 6 of Report 2 by Gilbert/Commonwealth. Also discharge is not directly to the river but to a swampy area and it is questionable as to how much if any of the estimated mass loading reaches the river.

If you have any questions please call.

B.S. McClellan

B.S. McClellan

BSM005:dm

TABLE I

Old Evaporation Pond, Well Analyses

For June 9, July 21 and August 11, 1982

mg/l

Well #	T.O.C. 6/9	T.O.C. 7/21	T.O.C. 8/11	Chloride 6/9	Chloride 7/21	Chloride 8/11	di-n-butyl-phthalate 6/9
1S	30	900	1000	950	1600	2157	$\leq$ 0.025
1D	13	100	(1)	855	1180	(1)	ND(2)
2S	29	28	24	440	410	547	ND(2)
2D	5	(1)	(1)	240	(1)	(1)	$\leq$ 0.030
3S	14	13	14	190	400	537	ND(2)
3D	5	7	6	174	250	239	$\leq$ 0.025
4S	20	34	360	1280	1390	1978	ND(2)
4D	8	8	11	273	235	249	ND(2)
5	14	16	18	370	370	403	ND(2)

Well #	1,1,1 trichloroethane 6/9	1,1,1 trichloroethane 7/21	1,1,1 trichloroethane 8/11	t-1,2-dichloroethylene 6/9	t-1,2-dichloroethylene 7/21	t-1,2-dichloroethylene 8/11	1,1 dichloroethane 6/9	1,1 dichloroethane 7/21	1,1 dichloroethane 8/1
1S	3.7	5.5	6.9	ND	ND	ND(3)	17	28	36
1D	0.13	0.12	(1)	ND	ND	(1)	ND	ND	(1)
2S	0.25	0.40	0.61	0.74	0.65	0.67	ND	ND	0.0
2D	ND	(1)	(1)	ND	(1)	(1)	ND	(1)	(1)
3S	0.30	1.0	1.7	ND	ND	0.01	ND	ND	0.0
3D	ND	ND	ND	ND	ND	ND	ND	ND	ND
4S	3	2.5	3.6	0.80	0.03	0.03	ND	0.40	0.3
4D	0.08	0.06	0.18	0.04	0.05	0.16	ND	ND	ND
5	0.25	0.20	0.31	0.14	0.25	0.40	ND	ND	ND

(1) Insufficient water for sampling.
(2) Detection limit about 0.02 mg/l.
(3) Detection limit about 1.0 mg/l in this sample.
(4) Other ND (None Detected) limits about 0.01 mg/l.

G. C. Philbrook
12-22-82

10

PERMEABILITY TESTING OF
OW-SERIES OBSERVATION WELLS
FOR
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Approved by:

Prepared by:

Commonwealth Associates Inc.
209 East Washington Avenue
Jackson, Michigan
October 14, 1982

Annette Brewster

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PERMEABILITY TESTING OF
OW-SERIES OBSERVATION WELLS
FOR
SWS SILICONES CORPORATION

INTRODUCTION

Field tests were performed in existing observation wells to obtain permeability estimates for granular soils around the former evaporation basin on the property of SWS Silicones Corporation (SWS), Adrian, Michigan. The tests were conducted on July 27-28, 1982. At the direction of Mr. B. S. McClellan of Stauffer Chemical Company, six of the nine observation wells around the basin were tested: OW-1s, OW-1d, OW-3s, OW-3d, OW-4s, and OW-4d.

Commonwealth Associates Inc. (Commonwealth) installed the OW-series observation wells during June 1980 as part of an investigation to determine the direction of ground water flow in the vicinity of the evaporation basin. Each well was constructed of 2-inch diameter, Schedule 80 PVC casing with 10 feet of slotted PVC screen (Timco). At each location referenced above, a pair of wells was installed and the well screens were set above and below a silty confining layer that begins between depths of 7 and 14 feet below ground. A well installation summary for the entire OW-series is presented in Table 1. Boring logs for OW-1, OW-3, and OW-4 are also attached.

TESTING PROCEDURES

Several factors affected the selection of a permeability testing method for the OW-series wells. Since the wells are used as ground water sampling points, testing methods which removed water from the wells were preferable to those which introduced water from another source. The selection was further limited because water levels in the three deep wells were below the level necessary for suction lift pumping. Static water levels only 5 to 8 feet above the base of the well screen were also marginal for the use of a small diameter submersible pump. Considering these factors, a procedure based upon the measured recovery of water levels following air-lift pumping was selected as an appropriate testing method.

The following procedure was used for the recovery tests. Prior to testing, the depths to water and to the bottom of the well were measured and recorded. Compressed air was then introduced to the bottom of the well to remove the column of standing water. A visible change in the ejection rate was judged to mark the time at which all standing water had been removed. Two Soiltest water level indicators were used to measure water level recovery. The straight line yielded by a plot of the depth to water during recovery versus the logarithum of time since the discharge (air-lift pumping) stopped was used in conjunction with the nonequilibrium formula to compute transmissivity and, from that, permeability.

The recovery procedure proved unsuccessful on wells OW-1d and OW-1s. Prior to testing of OW-1d, the well screen was found to be filled with more than 5 feet of sediment, even though the well had been cleaned out by SWS during the previous week. The level of sediment actually rose more than 1 foot in the well during air-lift pumping. In lieu of a field permeability test, a sample of the sediment blown out during cleaning operations was collected from the ground surface outside of the well casing for particle-size analysis. The permeability of this material was computed from the gradation curve using several accepted empirical equations.

An alternate method of testing well OW-1s had to be found because water levels recovered too quickly to be measured. Water level measurements in this well were also complicated by cascading water in the screened interval. A bailer test was attempted but was only partially successful. However, a record of the bailer volumes removed and the duration of bailing permitted computation of a minimum value for permeability.

CALCULATIONS

Recovery Tests

The governing equation for calculation of permeability from recovery test data is the modified nonequilibrium formula

$$T = \frac{264\ Q}{\Delta s}$$

where T is transmissivity in gallons per day/foot (gpd/ft), Q is the discharge rate in gallons per minute (gpm), and Δs is the change in water level in feet (ft) over one log cycle. However, transmissivity may also be defined as

$$T = km$$

where k is permeability in gpd/ft^2 and m is the saturated thickness in ft. Combination of the two equations yields the relation

$$K = \frac{264\ Q}{m\ \Delta s}$$

The permeability of the formation being tested may be calculated from this relation, with the value of Δs obtained from a plot of water levels measured during recovery versus the logarithum of time since discharge stopped. Permeability calculations are shown on the attached recovery plots for wells OW-3s, OW-3d, OW-4s, and OW-4d. Values of Q and m were determined in the following manner.

The discharge rate used in the computations equals the volume of standing water in the well divided by the duration of air-lift pumping required to remove it. The volume (V) of water in the well was computed from the relation

$$V = \pi (d/2)^2 h$$

where d is the inside diameter of the well screen and casing and h is the height of water in the well. For the wells tested, d = 0.15 ft, which is equivalent to 0.132 gal/ft of water in the well (h). Subtraction of the measured static water level from the measured depth to the bottom of the well provided the value of h. As mentioned earlier, the time required to remove one well volume of water by air-lift pumping was identified by a visible change in the ejection rate. Two assumptions are inherent in the computation of discharge rate by this method: 1) that all water standing in the well was removed during air-lift pumping, and 2) that water from the aquifer did not enter the well during pumping.

Values of m used in the computations were based upon consideration of the static water level and the formations present in the screened interval. It was assumed that all water entering the well during recovery was derived from the coarsest sediments in the screened interval below the water table. For the deep wells, m was assumed to be equal to the height of standing water in the well or the screened thickness of sand below the overlying, silty confining layer, whichever was smaller. For the shallow wells, m was generally assumed to be equal to the screened thickness of saturated sands above the confining layer. In well OW-3s, however, the saturated zone consisted entirely of sandy silt (ML). The approximate thickness and type of soils screened in each well are listed in Table 1.

Permeability calculations for wells OW-3s, OW-3d, OW-4s, and OW-4d are shown on the recovery data plots. Calculated permeability values range from 2.5×10^{-3} cm/sec for sandy silt in well OM-3s to 1.7×10^{-2} cm/sec for fine to coarse sand in well OM-4s. The value for well OM-4s is the average resulting from two tests. Test results are summarized in Table 2.

Bailer Test

The basis for computing the permeability of granular materials screened in OW-1s is the observation that water entered the well as fast as it was removed by bailing. Knowing the rate at which water entered the well permits the calculation of permeability from Darcy's Law, written as

$$K = \frac{Q}{iA}$$

where K and Q are as previously defined, i is the hydraulic gradient (dimensionless), and A is the surface area of the well screen (ft^2) across which water is flowing.

Prior to bailing, the static water level and depth to bottom of the well were measured at 14.28 ft and 20.00 ft, respectively. During bailing, the time was recorded each time the bailer was removed from the well. A stainless steel bailer having a volume of 0.28 gal was used for the test. Approximately 14 bailer volumes of water were removed. By dividing the total volume of water removed, 3.9 gal, by the total bailing time, 5.82 min, a discharge rate of 0.67 gpm was determined for the test.

For the bailer test, the hydraulic gradient, i, is the change in water level, Δh, divided by the radial distance, R, affected by the withdrawal of water from the well. Based upon the sound of water flowing over the top of the 5-foot long bailer, the apparent height of water in the well during bailing was approximately 5 ft. Taking into account the volume of water displaced by the bailer (0.211 gal), the actual height of water in the well during bailing was approximately 3.4 ft. Therefore, Δh is the actual height of water during bailing subtracted from the original height before bailing (5.7 ft), or 2.3 ft. The radial distance affected by bailing can only be estimated. For a test of such short duration and low discharge rate, R is not likely to exceed 1 foot. Therefore, a hydraulic gradient of 2.3 was used in the permeability calculation.

The area, A, across which water enters the well during recovery may be determined from the equation for surface area of a cylinder

$$A = 2\pi r_w L$$

where r_w is the radius of the well screen (ft) and L is the length of screen (ft) across which flow occurs. For the OW-series wells, r_w equals 0.075 ft. Two cases are considered. If water enters the well through the full length of screen below the static water level, then L is equivalent to the height of water in the well before bailing (h), or 5.7 ft. If, however, water enters the well only from the sandy soil (SW·SM) above the silty confining layer, L is equal to 1.8 ft.

Substitution of the appropriate values of Q, i, and A into the Darcy equation yields permeability values of 7.4×10^{-3} cm/sec for L = 5.7 ft and 2.3×10^{-2} cm/sec for L = 1.8 ft. Because the well was not totally evacuated during bailing, some water stored in the filter sand around the screen also entered the well during the test. Therefore, the actual permeability is probably an intermediate value between the two cases. Assuming a simple average as a first approximation, the permeability of the fine to coarse sand in well OW-1s is approximately 1.5×10^{-2} cm/sec.

Particle-Size Analysis

The permeability of the sandy soils screened in well OW-1d may be estimated from particle-size data taken from the attached gradation curve. Although the analyzed sand sample was obtained from the ground surface outside the well casing, it is believed to be representative of the sediment inside the well screen.

Three empirical methods were used to compute permeability: Hazen's Approximation, the method of Beyer (1969), and the method of Masch and Denny (1966). All three methods are described in Commonwealth Report No. R-2451, "Hydrogeologic Investigation of Disposal Area," for SWS Silicones Corporation. Permeability values calculated from these methods ranged from 2.0×10^{-3} to 7.3×10^{-3} cm/sec, and averaged 3.8×10^{-3} cm/sec.

DISCUSSION

Permeability values for granular soils in the six tested observation wells are listed in Table 2. Limitations on the accuracy of the permeability values reported in Table 2 should be understood before they are used to calculate ground water flow rates. The various assumptions described in the calculations section introduce a degree of uncertainty to each permeability value. Moreover, direct comparison of permeability from one well and soil type to another is complicated because three different methods were used. For example, a recovery test was performed during development of well M-1 in the disposal on June 14, 1982, using the same testing procedure described in this letter report. The resulting permeability was 2.9×10^{-3} cm/sec. Based upon particle-size data for boring M-1 (samples 11 and 12), an average permeability of 4.9×10^{-3} cm/sec was calculated. Thus, it appears that permeability values computed from particle-size data are higher than those from recovery test data. If a recovery test could have been performed in well OW-1d instead of a particle-size analysis, the reported permeability value would probably be lower than 3.8 X 10^{-3} cm/sec (Table 2). Unfortunately, a similar comparison between bailer test results and the other test methods cannot be made since the bailer test was performed in only one well.

In general, the permeability of the upper sand layer is higher than that of the sand below the confining layer. This result was expected because the OW-series borings indicated the presence of coarser soils above the confining layer. For √ok the purposes of future computations, we recommend using a 56.7 ft/day permeability value of 2 X 10^{-2} cm/sec for the upper fine to .5 ft/day coarse sand layer and 3 X 10^{-3} cm/sec for the lower silty sand layer. These values reflect the relative permeability difference between the upper and lower sand layers and are considered accurate to within one-half an order of magnitude.

INSTALLATION SUMMARY FOR
OW-SERIES OBSERVATION WELLS
TABLE 1

Well No.	Date Installed	Surveyed Elevation Top of PVC ft	Measured PVC Height Above Ground ft	Ground Elevation ft	Screened Interval Depth ft / Elevation ft	Elevation, Top of Sand Filter ft	Elevation, Top of Bentonite ft	Approx. Thickness of Screened Formation ft
OW-1d	6/20/80	752.77	0.8	752.0	30.8-40.8/712.0-722.0	724.5	727.5	7'ML/3'SP·SM
OW-1s	6/20/80	754.08	1.3	752.8	10.6-20.6/733.5-743.5	747.8	749.8	5.5'SW·SM/4.5'ML
OW-2d	6/23/80	755.91	2.1	753.8	27.6-37.6/718.3-728.3	731.8	734.8	3.5'ML/6.5'SM
OW-2d	-	761.91	3.1	758.8	33.6-43.6/718.3-728.3	731.8	734.8	
OW-2s	6/24/80	757.22	3.2	754.0	12.7-22.7/734.5-744.5	747.0	750.0	2.5'SM/7'ML/0.5'CL
OW-2s	-	761.83	3.9	757.9	17.3-27.3/734.5-744.5	747.0	750.0	
OW-3d	6/25/80	763.49	2.8	760.7	32.8-42.8/720.7-730.7	738.7	741.7	2'ML/8'SM
OW-3s	6/25/80	764.23	3.3	760.9	10.3-20.3/743.9-753.9	754.9	757.9	10'ML
OW-4d	6/26/80	748.51	3.6	744.9	30.6-40.6/707.9-717.9	720.9	723.9	8'ML/2'SM
OW-4s	6/27/80	748.09	2.9	745.2	6.4-16.4/731.7-741.7	742.2	744.2	6.5'SW/3.5'ML
OW-5	6/24/80	722.77	3.2	719.6	8.2-18.2/704.6-714.6	715.6	717.1	2'SW/4.5'ML·CL/ 3.5'SC

Notes:

1. All depths are below top of PVC casing.

2. During dike construction, the top of wells OW-2d and OW-2s was raised by adding 6.0 and 4.6 feet of PVC casing to the wells, respectively. Top of PVC elevations were not resurveyed.

RESULTS OF PERMEABILITY TESTS
CONDUCTED JULY 27-28, 1982

TABLE 2

Well No.	Test Type	Permeability, cm/sec	Soil Description(1)
OW-1s	Bailer	1.5×10^{-2}	Fine-coarse sand
OW-1d	Particle-size	3.8×10^{-3} (2)	Silty fine sand
OW-3s	Recovery	2.5×10^{-3}	Sandy silt
OW-3d	Recovery	2.8×10^{-3}	Silty fine sand
OW-4s	Recovery	1.7×10^{-2} (3)	Fine-coarse sand
OW-4d	Recovery	3.8×10^{-3}	Silty fine sand

Notes:
(1) Coarsest saturated soils within screened interval.

(2) Average of three values.

(3) Average of two values.

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-1

SURFACE ELEVATION 752.1
COORDINATE 1298 S – 3612E

ELEV. IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD	% PASSING 200 SIEVE	DEPTH IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
										5	10	⊠	SM	Brown fine to medium SAND, some silt. (Fill) (Medium Dense)
									8.6	10	15	⊠		
													SW SM	Varicolored fine to coarse SAND and fine gravel, trace silt.
										15	36	⊠	ML	Light gray-brown SILT, some fine sand. (Medium Dense)
									87.2		23	⊠		
										S 20	46	⊠		Grades to gray, thin clay seams noted.
											17	⊠		
			28.4	11.6	22.4				90.1	25	16	⊠	CL	Gray CLAY, trace silt, coarse sand noted. (Stiff)
											15	⊠		
									68.8	30	49	⊠	ML	Gray SILT, some fine sand. (Very Dense)
										35	58	⊠		
									6.4	40 D	64	⊠	SP SM	Brown fine SAND, trace silt. (Very Dense)
														Boring terminated at 40' on 6/20/80. Water level encountered at 10.8' and 31.4'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 40.0 feet; gravel packed to a depth of 27.5 feet; bentonite seal from a depth of 24.5 to 27.5 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 19.3 feet; gravel packed to a depth of 5.0 feet; bentonite seal from a depth of 3.0 to 5.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ■ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- □ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
- P — HYDRAULICALLY PUSHED
- TV — TORVANE TEST
- UC — UNCONFINED COMPRESSION TEST
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC STU
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-3

SURFACE ELEVATION 760.7
COORDINATE 897S - 3512E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD		DEPTH IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
									38.6	5	9	⊠	SM	Brown fine to coarse SAND and SILT. (Fill) (Loose)
										10	10	⊠	ML	Brown SILT, some fine sand.
									74.7	15	32	⊠		Grades to gray. (Graded Dense)
		PN-2750	30.4	13.0	19.2						17	⊠	CL	Gray CLAY. (Stiff) Grades with silt seams.
		PN-3700								20	29	⊠		Grades with silt seams.
									71.2	25	72	⊠	ML	Gray SILT, some fine sand. (Very Dense)
										30	37	⊠		(Grades Dense) Grades to tan.
										35	60	⊠	SM	Brown fine SAND, trace silt. (Very Dense)
										40	78	⊠		Boring terminated at 40.5' on 6/25/80. Water level encountered at 7.7' and 33.7'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 40.0 feet; gravel packed to a depth of 22.0 feet; bentonite seal from a depth of 19.0 to 22.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 17.0 feet; gravel packed to a depth of 6.0 feet; bentonite seal from a depth of 3.0 to 6.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

⊠ — STANDARD PENETRATION TEST
■ — UNDISTURBED SOIL SAMPLE
◩ — DISTURBED SOIL SAMPLE
☐ — LOST SOIL SAMPLE
CR — CORE RUN NO.
22 — BLOWS PER FOOT
P — HYDRAULICALLY PUSHED
TV — TORVANE TEST
UC — UNCONFINED COMPRESSION TEST
Gs — SPECIFIC GRAVITY
C — CONSOLIDATION TEST
PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth

HYDROGEOLOGIC STUDY
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

BORING OW-4

SURFACE ELEVATION 744.9'
COORDINATE 1276 S – 3762E

ELEV IN FEET	OTHER TESTS	SHEAR STRENGTH TEST (PSF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FIELD MOISTURE CONTENT (%)	DRY DENSITY (PCF)	PERCENT RECOVERY (%)	RQD		DEEP IN FEET	BLOW COUNT	SAMPLES	SYMBOLS	DESCRIPTION
													SW	Brown fine to coarse SAND. (Medium Dense)
									2.4	5	12	⊠		
										10	27	⊠		
													ML	Tan SILT, trace fine sand. (Medium Dense)
									99.0	15	18	⊠		
											21	⊠		Grades to gray.
										20	12	⊠	CL	Gray CLAY. (Stiff)
		PN-2250	31.6	11.7	23.0						14	⊠		
										25	13	⊠		
									61.6	30	47	⊠	ML	Gray SILT, some fine sand. (Dense)
										35	69	⊠		
													SM	Gray fine SAND, trace silt. (Very Dense)
									6.7	40	62	⊠		Boring terminated at 40' on 6/26/80 Water level encountered at 4.5' and 28.0'
										45				
										50				
										55				
										60				

Monitoring wells were installed in two separate borings within a 5-foot diameter circle. All wells had a 10-foot long preslotted screen as the bottom section. The deep well had the screen tip at a depth of 37.0 feet; gravel packed to a depth of 24.0 feet; bentonite seal from a depth of 21.0 to 24.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface. The shallow well had the screen tip at a depth of 13.5 feet; gravel packed to a depth of 3.0 feet; bentonite seal from a depth of 1.0 to 3.0 feet; and bentonite-cement grout from the bentonite seal to the ground surface.

LEGEND

- ⊠ — STANDARD PENETRATION TEST
- ▣ — UNDISTURBED SOIL SAMPLE
- ◪ — DISTURBED SOIL SAMPLE
- ☐ — LOST SOIL SAMPLE
- CR — CORE RUN NO.
- 22 — BLOWS PER FOOT
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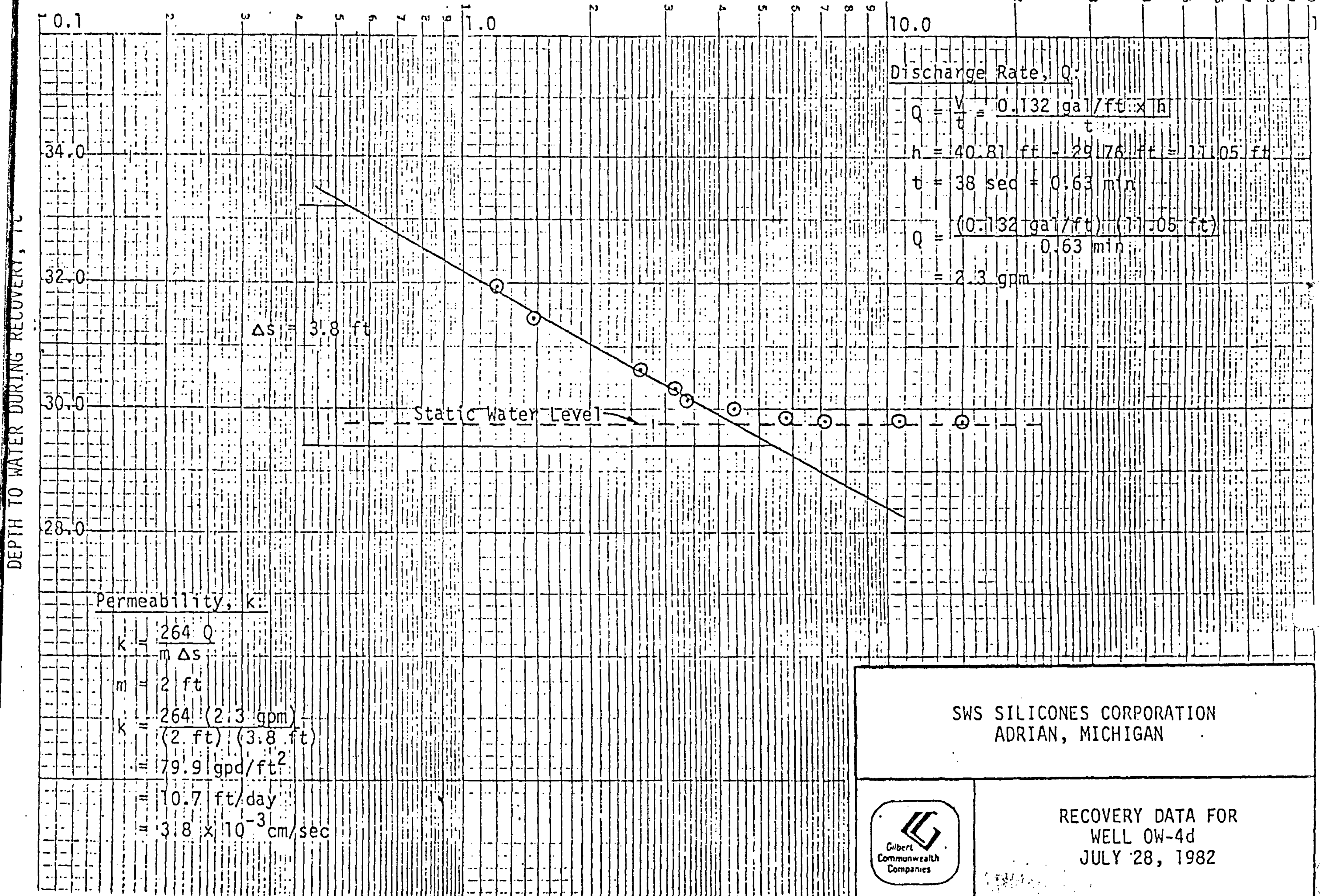
- Gs — SPECIFIC GRAVITY
- C — CONSOLIDATION TEST
- PN — PENETROMETER

LOG OF BORING

Gilbert/Commonwealth



Discharge Rate, Q:

$$Q = \frac{V}{t} = \frac{0.132\ \text{gal/ft} \times h}{t}$$

$$h = 40.81\ \text{ft} - 29.76\ \text{ft} = 11.05\ \text{ft}$$

$$t = 38\ \text{sec} = 0.63\ \text{min}$$

$$Q = \frac{(0.132\ \text{gal/ft})\ (11.05\ \text{ft})}{0.63\ \text{min}}$$

$$= 2.3\ \text{gpm}$$

Permeability, k:

$$k = \frac{264\ Q}{m\ \Delta s}$$

$$m = 2\ \text{ft}$$

$$k = \frac{264\ (2.3\ \text{gpm})}{(2\ \text{ft})\ (3.8\ \text{ft})}$$

$$= 79.9\ \text{gpd/ft}^2$$

$$= 10.7\ \text{ft/day}$$

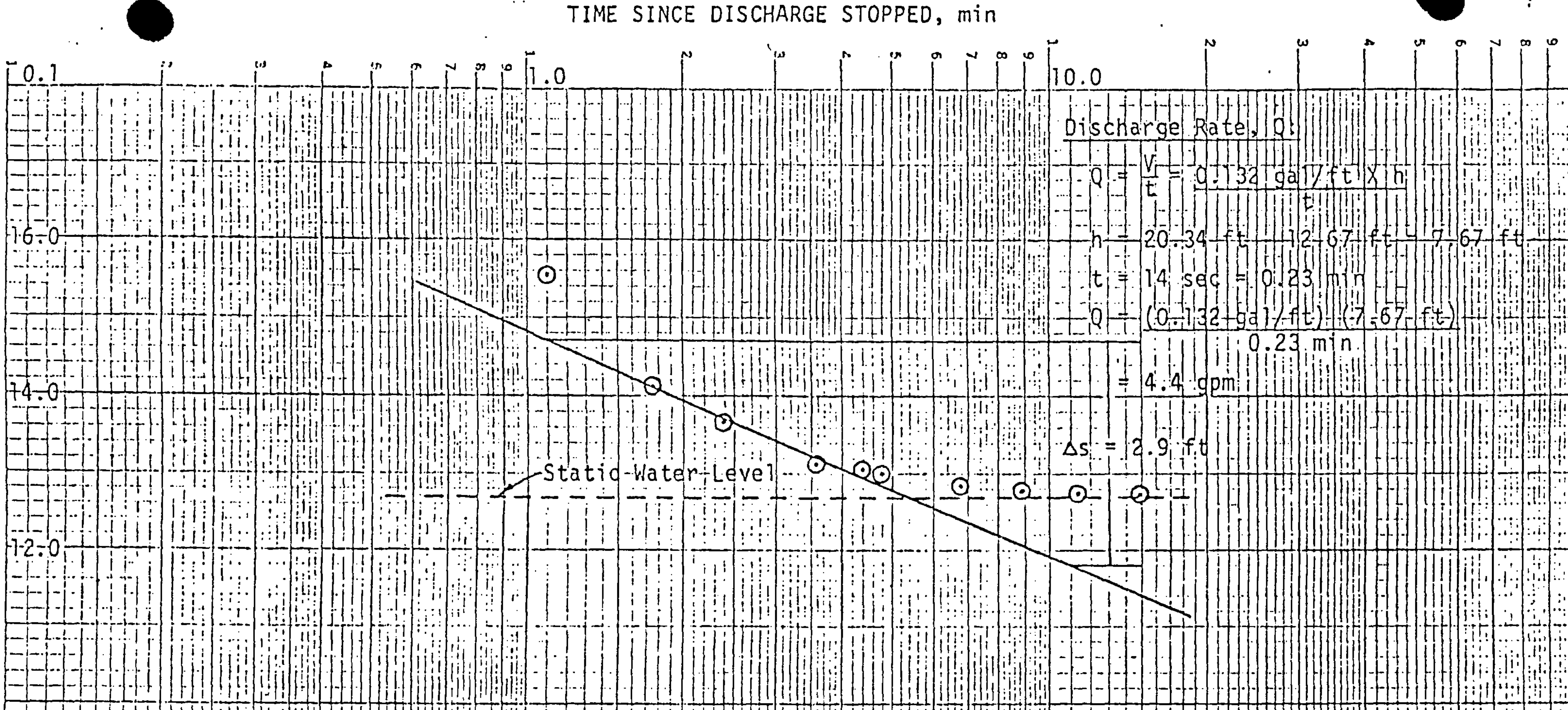
$$= 3.8 \times 10^{-3}\ \text{cm/sec}$$

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

RECOVERY DATA FOR
WELL OW-4d
JULY 28, 1982

(24)



Discharge Rate, Q:

$$Q = \frac{V}{t} = \frac{0.132\ \text{gal/ft} \times h}{t}$$

$h = 20.34\ \text{ft} - 12.67\ \text{ft} = 7.67\ \text{ft}$

$t = 14\ \text{sec} = 0.23\ \text{min}$

$$Q = \frac{(0.132\ \text{gal/ft})\ (7.67\ \text{ft})}{0.23\ \text{min}}$$

$= 4.4\ \text{gpm}$

$\Delta s = 2.9\ \text{ft}$

Permeability, k:

$$k = \frac{264\ Q}{m\ \Delta s}$$

$m = 7.67\ \text{ft}$

$$k = \frac{264\ (4.4\ \text{gpm})}{(7.67\ \text{ft})\ (2.9\ \text{ft})}$$

$= 52\ \text{gpd/ft}^2$

$= 7.0\ \text{ft/day}$

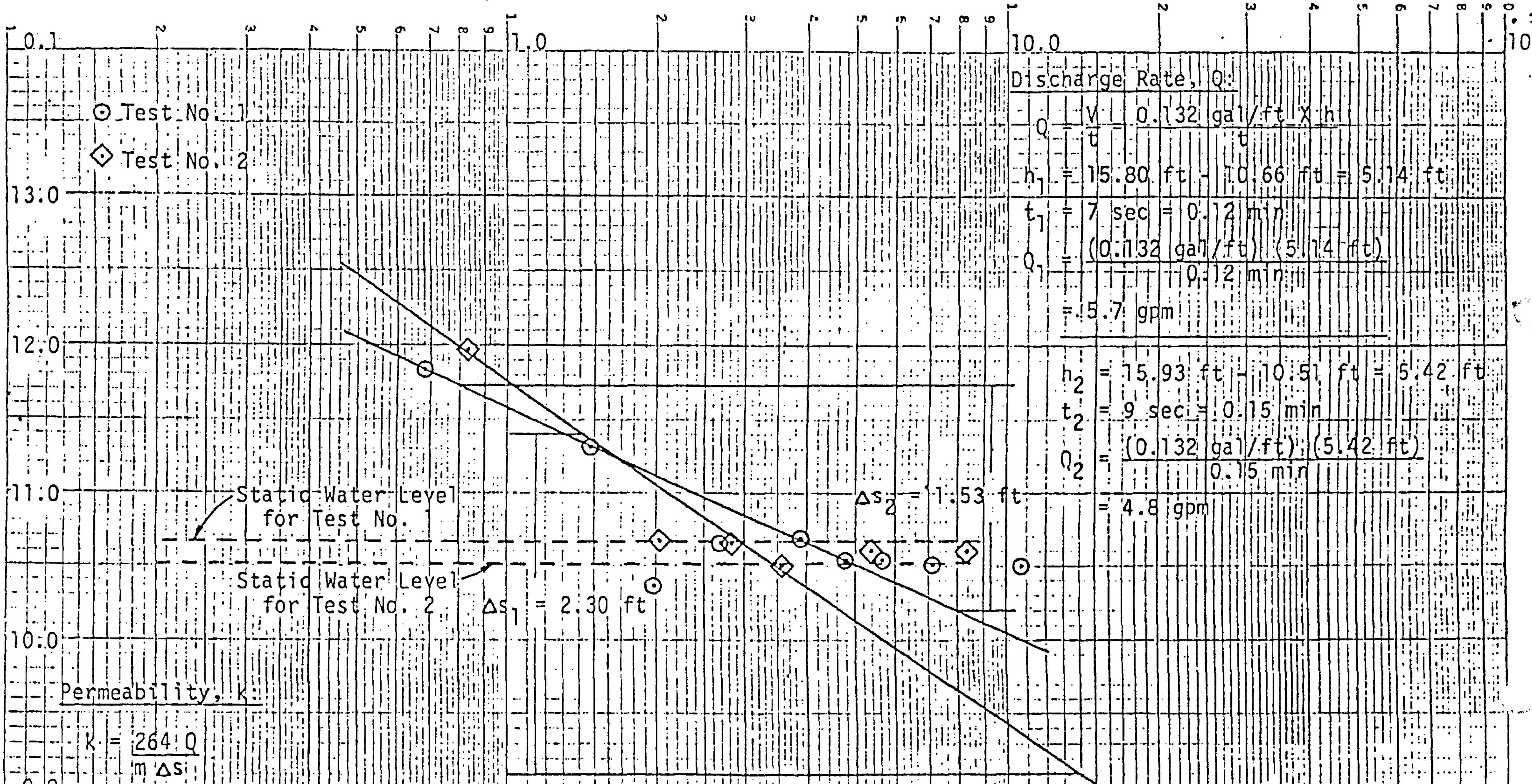
$= 2.5 \times 10^{-3}\ \text{cm/sec}$

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

RECOVERY DATA FOR
WELL OW-3s
JULY 27, 1982

25



Discharge Rate, Q:

$Q = \frac{V}{t} = \frac{0.132 \text{ gal/ft} \times h}{t}$

$h_1 = 15.80 \text{ ft} - 10.66 \text{ ft} = 5.14 \text{ ft}$

$t_1 = 7 \text{ sec} = 0.12 \text{ min}$

$Q_1 = \frac{(0.132 \text{ gal/ft})(5.14 \text{ ft})}{0.12 \text{ min}}$

$= 5.7 \text{ gpm}$

$h_2 = 15.93 \text{ ft} - 10.51 \text{ ft} = 5.42 \text{ ft}$

$t_2 = 9 \text{ sec} = 0.15 \text{ min}$

$Q_2 = \frac{(0.132 \text{ gal/ft})(5.42 \text{ ft})}{0.15 \text{ min}}$

$= 4.8 \text{ gpm}$

Permeability, k:

$k = \frac{264\,Q}{m\,\Delta s}$

$m_1 = 2.0 \text{ ft}$

$k_1 = \frac{264\,(5.7 \text{ gpm})}{(2.0 \text{ ft})(2.30 \text{ ft})}$

$= 327 \text{ gpd/ft}^2$

$= 43.7 \text{ ft/day}$

$= 1.5 \times 10^{-2} \text{ cm/sec}$

$m_2 = 2.2 \text{ ft}$

$k_2 = \frac{264\,(4.8 \text{ gpm})}{(2.2 \text{ ft})(1.53 \text{ ft})}$

$= 376 \text{ gpd/ft}^2$

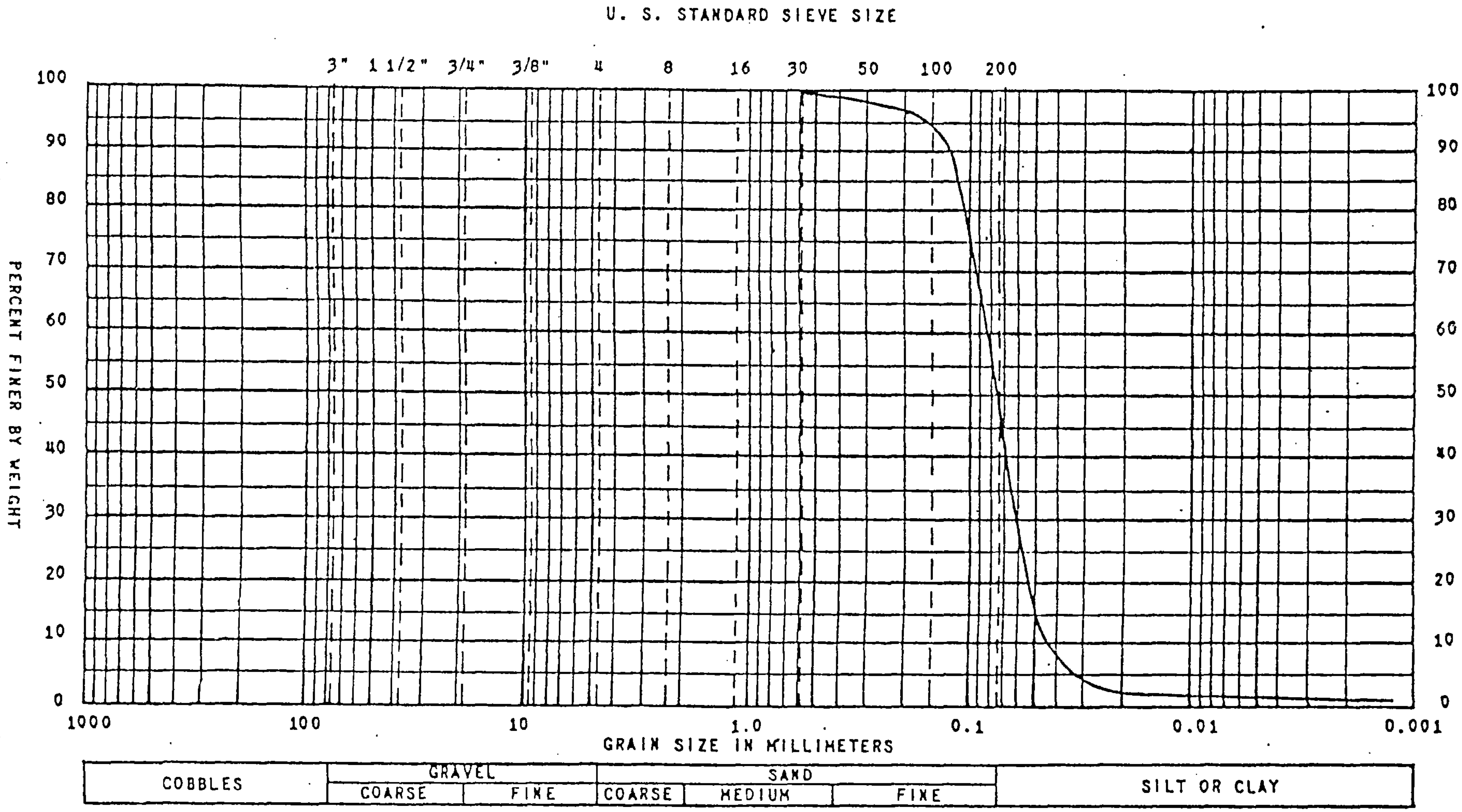
$= 50.3 \text{ ft/day}$

$= 1.8 \times 10^{-2} \text{ cm/sec}$

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

RECOVERY DATA FOR
WELL OW-4s
JULY 28, 1982



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
OW-1d	*	SM	SILTY SAND					

* Sand from screened interval.

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

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GRADATION CURVE
FROM WELL OW-1d

(27)

GROUND WATER FLOW BENEATH
THE SEALED EVAPORATION AND
SETTLING BASIN
AT
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Approved by:

Prepared by:

Commonwealth Associates Inc.
209 East Washington Avenue
Jackson, Michigan
December 13, 1982

Annette Brewster

Annette Brewster
Senior Geologist/Hydrogeologist
Industrial & Environmental Div.

GROUND WATER FLOW BENEATH THE SEALED EVAPORATION AND SETTLING BASIN AT SWS SILICONES CORPORATION ADRIAN, MICHIGAN

INTRODUCTION

During the summer of 1982, SWS Silicones Corporation (SWS) removed from service and sealed over an evaporation and settling basin located in the southeast portion of their plant site near Adrian, Michigan. Commonwealth Associates Inc. (Commonwealth) was retained in October 1982 to determine the quantity of ground water passing beneath the basin. The results of Commonwealth's investigations, analytical procedures and data and assumptions used in the analysis are presented in this letter report.

EXISTING HYDROGEOLOGIC CONDITIONS

Soil Sequence

Logs of the B-series and OW-series borings were reviewed to establish the soil sequence in the vicinity of the evaporation and settling basin. These logs were originally presented in Commonwealth Report R-2194, "Hydrogeologic Study for Evaporation and Settling Basin." Boring locations are shown on Figure 1, Site Topography and Plot Plan, along with the configuration of the evaporation and settling basin before sealing.

Subsurface geologic profiles through the basin area are shown on Figures 2 and 3. To construct the profiles, contour maps were first prepared for the four major soils changes indicated on the boring logs. Profiles of the contacts between soil types were then developed by superimposing the profile lines shown on Figure 1 onto each contour map. The different soil types on the boring logs and profiles are based upon the Unified Soil Classification System, which is described on Figure 4.

In descending order, the soil sequence shown on the profiles consists of an upper sand layer (SW·SM), very fine sand and organic silt (ML), silty clay (CL), a second layer of very fine sand and silt (ML), and a lower layer of sand (SP·SM). The base of the lower sand layer is not shown because the borings were terminated in this layer. All of the layers present in the basin area were assumed to be continuous to the river bluff. The assumed sequence of upper floodplain soils on all three profiles is based upon soils encountered in boring OW-5.

Ground Water Flow Systems

As documented in Commonwealth Report R-2194, two ground water flow systems occur in the upper 40 feet of unconsolidated soils in the vicinity of the evaporation and settling basin. The upper sand (SW·SM) and silt (ML) comprise the shallow aquifer while the lower silt (ML) and sand (SP·SM) comprise the deep aquifer. In the 1980 report, these aquifers were labeled "perched" and "normal," respectively. Soils immediately below the silty clay layer were unsaturated, indicating that the CL layer acts as a confining layer between the two aquifers.

A pair of observation wells was installed at four locations in the basin area during June 1980 to permit periodic measurements of ground water levels in the shallow and deep aquifers. A ninth observation well was installed at the northern edge of floodplain deposits along the River Raisin (Figure 1). Ground water levels recorded for both aquifers are summarized in Table 1.

Ground water contours for the shallow and deep aquifers on October 15, 1982 are shown on Figures 5 and 6, respectively. Flow lines drawn orthogonal to the contours illustrate the direction of ground water flow in each aquifer. Ground water in the shallow aquifer beneath the former evaporation and settling basin is moving to the south and southeast under an average gradient of approximately 0.027 (27 feet in 1,000 feet). average
Ground water in the deep aquifer, however, is flowing entirely to the

southeast under an average gradient of approximately 0.019. Water table profiles shown on Figures 2 and 3 reflect the water levels measured on October 15, 1982. As shown on Figures 2 and 3, water in the shallow aquifer discharges along the slope from the upland to the floodplain while water in the deep aquifer discharges to the floodplain swamp and the River Raisin.

Based upon contour maps plotted (but not shown here) for July 1, 1980 and May 26, 1982, ground water flow directions in both aquifers have not changed substantially since the observation wells were first installed. In fact, ground water contours for the deep aquifer on July 1, 1980 are virtually identical to those shown on Figure 6. Deep aquifer contours for May 26, 1982 have the same orientation, but reflect water levels 1 to 2 feet higher than those measured on October 15, 1982. The same relationships do not hold, however, for the shallow aquifer. Although the shallow aquifer contours for July 1, 1980 and May 26, 1982 are nearly the same, ground water levels measured on both dates are 3 to 4 feet higher than water levels measured on October 15, 1982. Also, the contours shown on Figure 5 are less strongly curved than those for either of the previous dates.

Soil Permeabilities

Permeability values to be used in calculating discharge from the shallow and deep aquifers were established from field permeability tests conducted by Commonwealth in six observation wells around the evaporation and settling basin. Permeability test results were summarized in a previous letter report dated October 14, 1982.

Recommended permeability values for the upper sand (SW-SM) and lower sand (SP-SM) layers are 2.0×10^{-2} cm/sec and 3.0×10^{-3} cm/sec, respectively. These values correspond to 57 ft/day for the upper sand and 8.5 ft/day for the lower sand. Based upon the test results for well OW-3s, the permeability of the sandy silt (ML) is 2.5×10^{-3} cm/sec (7.1 ft/day). This well is screened entirely within the upper ML layer. Since the silt (ML) layer of the deep aquifer was not tested, the permeability is assumed to be the same as for the upper ML layer.

DISCHARGE ANALYSES

Theoretical Basis

Commonwealth was requested to calculate the quantity of ground water reaching the River Raisin or adjacent swamp that also passes beneath the sealed evaporation and settling basin. The computations described herein are based upon ground water flow (potential) theory and the law of mass conservation.

According to the theory of ground water flow, lines drawn orthogonal to equipotential lines (ground water contours) represent impermeable boundaries across which flow does not occur. The area between any two flow lines is called a flow channel. By the law of mass conservation, the quantity of ground water moving in any particular flow channel must be constant unless water is added from an outside source (recharge) or is removed from the flow channel (discharge). For these calculations, it was assumed that there is no recharge to or discharge from either the shallow or deep aquifer in the basin area. This is a reasonable assumption because the cooling lagoons south of the evaporation and settling basin are fully lined.

Analytical Procedures

On Figures 5 and 6, the outer flow lines for each aquifer have been drawn to encompass the evaporation and settling basin in a single flow channel. The quantity of water reaching the bluff or swamp that also passes beneath the basin may be calculated from the relation

$$Q = KiA \qquad \text{(Equation 1)}$$

In this form of Darcy's law, Q is the discharge rate in cubic feet per day (ft^3day), K is the hydraulic conductivity (permeability) of the saturated materials in ft/day, i is the dimensionless hydraulic gradient, and A is the cross-sectional area normal to the direction of flow. The parameter A may also be written

$$A = mL \qquad \text{(Equation 2)}$$

where m is the saturated thickness of the aquifer and L is the length of any equipotential line between the outer flow lines. Both m and L are in feet (ft).

It was previously established that, in the absence of recharge or discharge, the discharge rate, Q, is constant throughout the length of any flow channel. Therefore, Q will be the same whether it is calculated at the bluff or the edge of the evaporation and settling basin. An arbitrary equipotential line between the outer flow lines and tangent to the southeast corner of the former basin was selected as the line across which the discharge rate would be calculated for each aquifer. This equipotential is indicated on Figures 5 and 6 by a heavy dashed line. Values of k, m, and i are relatively well known at these locations.

As indicated by the geologic profiles and water level measurements in the observation wells, ground water is moving through both the sand and silt layers in each aquifer. Total aquifer discharge, Q_T, is the sum of discharge through the sand layer, Q_{sd}, and discharge through the silt layer, Q_{st},

$$Q_T = Q_{sd} + Q_{st} \qquad \text{(Equation 3)}$$

Darcy's law applied to each layer yields

$$Q_{sd} = (K_{sd})(m_{sd})iL \text{ and} \qquad \text{(Equation 4A)}$$

$$Q_{st} = (K_{st})(m_{st})\,iL \qquad \text{(Equation 4B)}$$

Substituting Equations 4A and 4B into Equation 3 results in

$$Q_T = [(K_{sd})(m_{sd}) + (K_{st})(m_{st})]iL \qquad \text{(Equation 5)}$$

Calculations

Permeability and hydraulic conductivity values to be used in the discharge calculations are provided earlier in this report. The parameter L is the length of the dashed equipotential line shown on Figures 5 and 6. L is 300 feet for the shallow aquifer and 279 feet for the deep aquifer.

A three-step process was used to establish the saturated thicknesses, m, of all layers except the lower sand. First, profile lines A-A', B-B', and C-C' (Figure 1) were superimposed on the ground water contour maps to locate the point where the dashed equipotential line crosses the profile lines. Next, the saturated thicknesses at that point were determined from the profiles. On October 15, 1982, the saturated thickness ranged from 0.0 to 0.5 ft for the upper sand, 2.5 to 8.5 ft for the upper silt, and 5.0 to 6.0 ft for the lower silt. Finally, values of m were averaged for each layer to obtain a single value for use in the calculations. NO. (worst case)

m_1 "

The saturated thickness of the lower sand cannot be determined from existing data. A value may be estimated, however, based upon an understanding of ground water flow theory. According to the theory, vertical (upward) components of flow associated with discharge areas would prevent convective mixing of ground water between the upper and lower portions of the aquifer. Available data indicate that ground water in the deep aquifer is discharging to the floodplain swamp and River Raisin. Therefore, the effective saturated thickness for computing the quantity of ground water affected by the evaporation and settling basin would be less than the total saturated thickness of the aquifer. An effective saturated thickness of 3 feet has been assumed for the lower sand. If a different value can be shown to be more appropriate, the daily discharge from the deep aquifer can be readily computed by substituting the new value for m_{sd} into Equation 5.

$m_2 = 3$ ft

For the shallow aquifer, the discharge rate from the flow channel shown on Figure 5 was calculated using the following values for K, m, i, and L:

$K_{sd} = 57$ ft/day　　$K_{st} = 7.1$ ft/day

$m_{sd} = 0.2$ ft　　$m_{st} = 6.2$ ft

$i = 0.027$　　$L = 300$ ft

Substitution of these values into Equation 5 yields

$$Q_T = 449 \text{ ft}^3\text{/day (3359 gallons/day)}$$

for the shallow aquifer.

Values of k, m, i, and L used in calculating the discharge rate from the flow channel shown on Figure 6 were:

$K_{st} = 7.1$ ft/day　　$K_{sd} = 8.5$ ft/day

$m_{st} = 5.5$ ft　　$m_{sd} = 3.0$ ft

$i = 0.019$　　$L = 279$ ft

Substitution of these values into Equation 5 yields

$$Q = 342 \text{ ft}^3\text{/day (2558 gallons/day)}$$

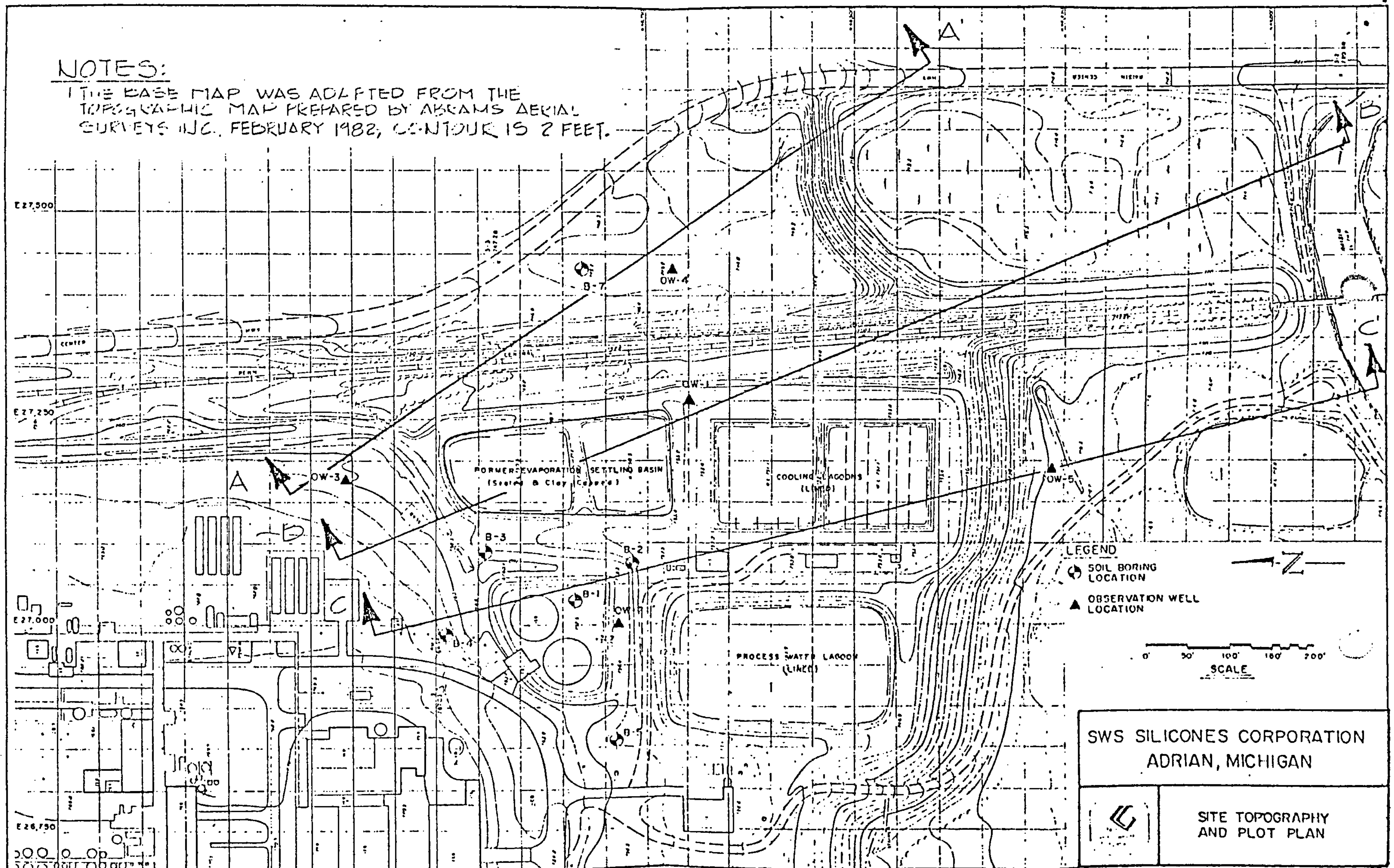
for the deep aquifer.

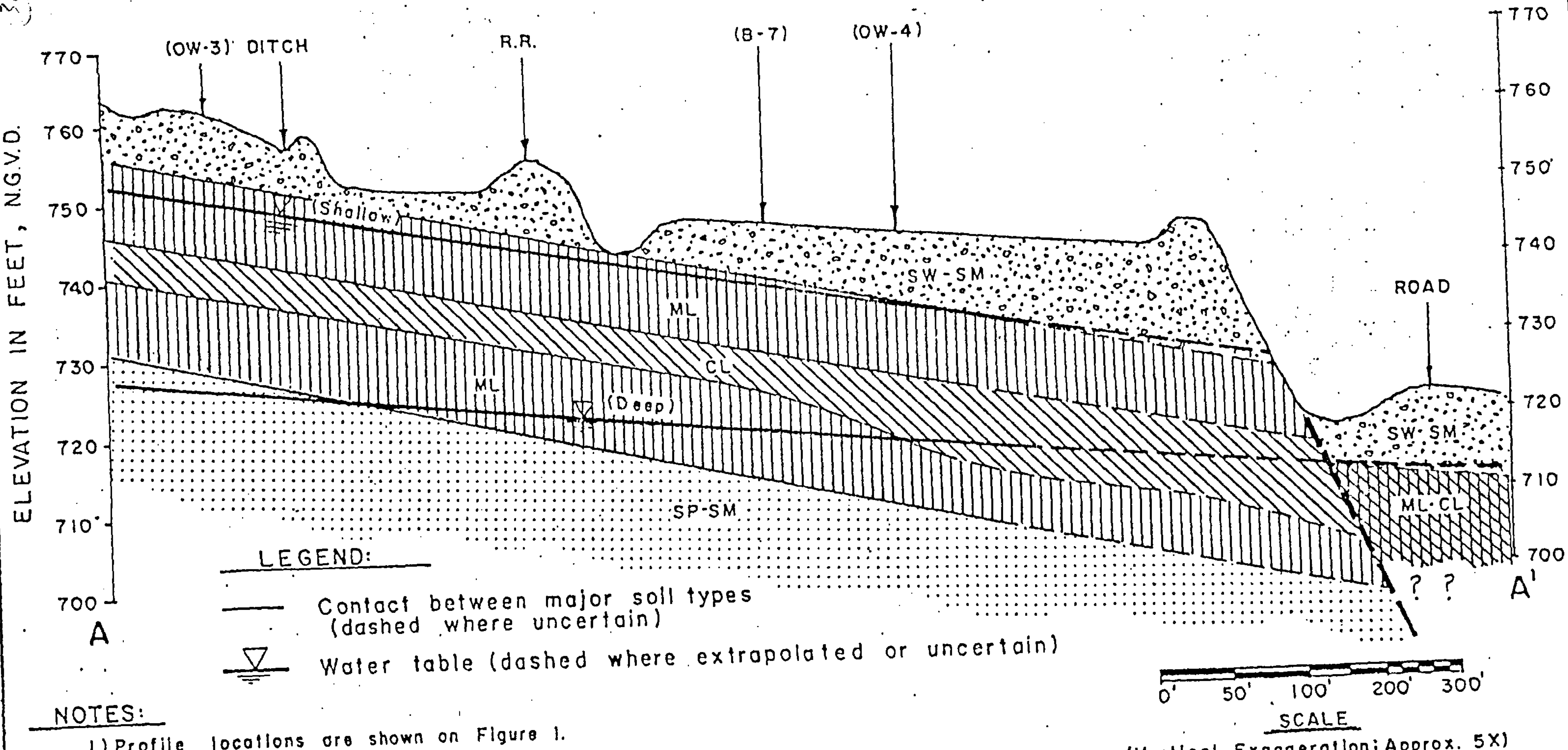
TABLE 1

SUMMARY OF RECORDED WATER LEVELS
FOR THE SHALLOW AND DEEP AQUIFERS

	Well No.	7/1/80	8/80	5/26/82	6/8/82	8/11/82	10/15/82	11/18/82
Shallow Aquifer	OW-1s	741.6	741.9	741.7	741.0	739.3	738.3	739.1
	OW-2s	743.2	742.9	742.8	742.8	741.8	740.8	741.1
	OW-3s	753.0	752.7	752.6	752.6	750.9	750.2	751.2
	OW-4s	739.7	739.3	740.3	739.1	737.0	735.9	737.3
Deep Aquifer	OW-1d	720.2	720.2	722.0	721.2	720.6	720.4	720.3
	OW-2d	725.8	725.9	727.1	727.1	727.4	725.9	726.6
	OW-3d	726.7	726.5	728.4	728.4	727.2	727.3	727.5
	OW-4d	718.6	718.7	720.1	719.5	718.5	718.6	719.0
	OW-5	715.9	716.4	717.3	717.0	715.4	715.8	716.5

36


NOTES:
1 THE BASE MAP WAS ADAPTED FROM THE TOPOGRAPHIC MAP PREPARED BY ABRAMS AERIAL SURVEYS INC. FEBRUARY 1982, CONTOUR IS 2 FEET.
A
A'
B
B'
C
C'
E 27,500
E 27,250
E 27,000
E 26,750
B-7
OW-4
OW-1
OW-3
OW-5
B-3
B-2
B-1
B-4
FORMER EVAPORATION SETTLING BASIN (Sealed & Clay Capped)
COOLING LAGOONS (LINED)
PROCESS WATER LAGOON (LINED)
LEGEND
SOIL BORING LOCATION
OBSERVATION WELL LOCATION
0' 50' 100' 150' 200'
SCALE
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
SITE TOPOGRAPHY AND PLOT PLAN
FIGURE 1



NOTES:

1.) Profile locations are shown on Figure 1.

2.) Soil borings projected to the profile line are enclosed in parentheses.

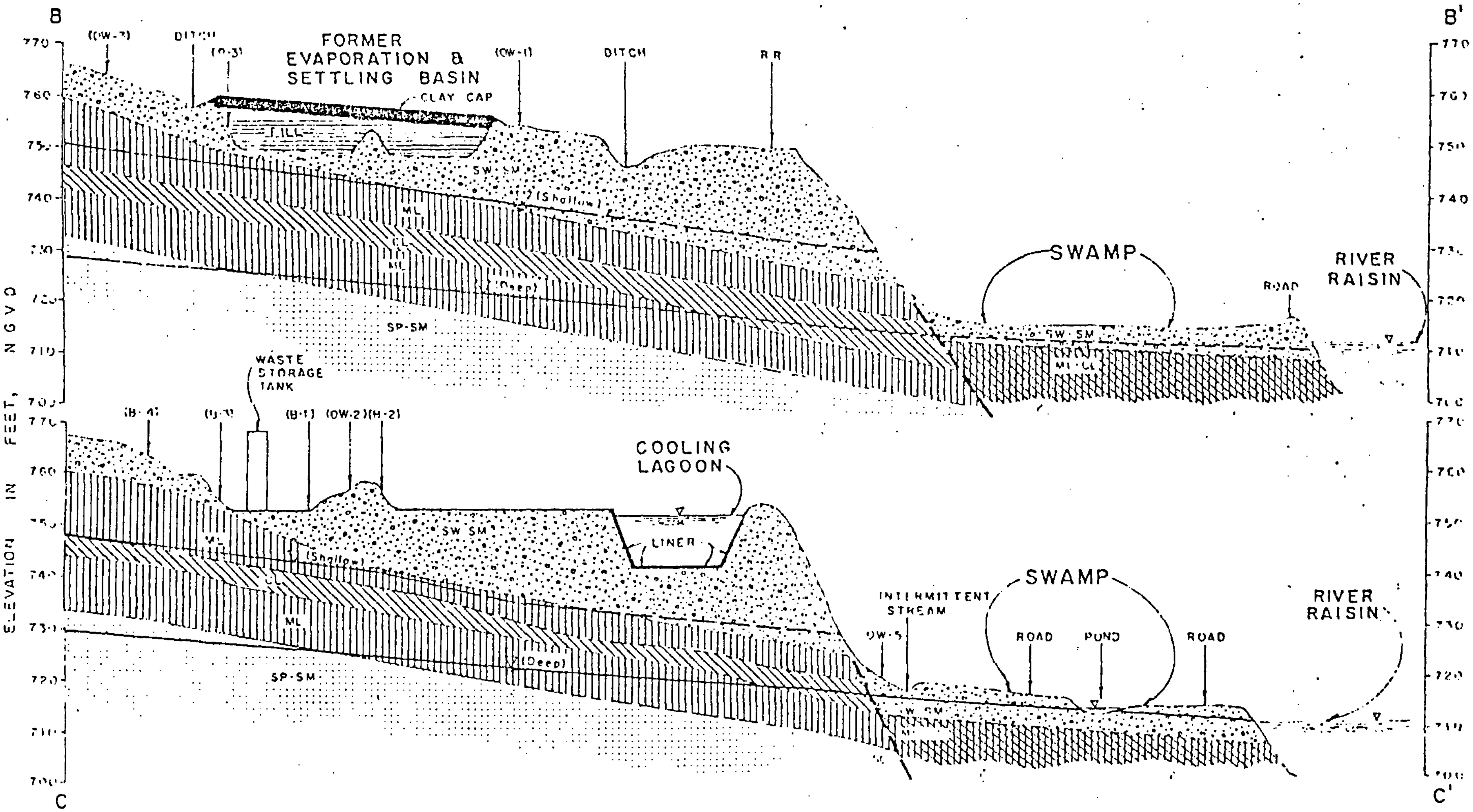
3.) Abbreviations for general soil types shown on the profile are described on Figure 4.

4.) Water table profiles are based upon water levels measured in the shallow and deep wells on October 15, 1982.

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

Gilbert Commonwealth Companies

GEOLOGIC PROFILE A-A'



NOTE

1) The legend and notes for these profiles are given on Figure 2.

0' 50' 100' 200' 300'

SCALE

(Vertical Exaggeration Approx 5X)

SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

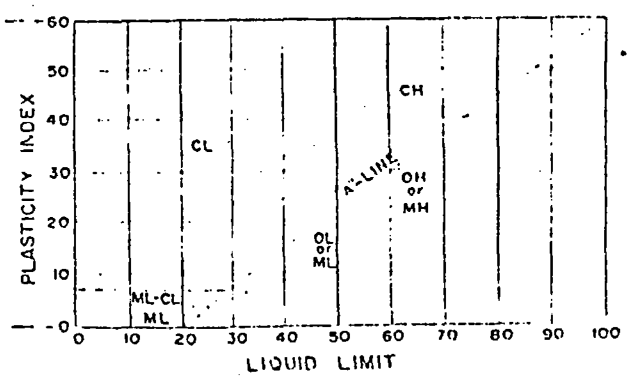
GEOLOGIC PROFILES B-B' AND C-C'

FIGURE 3

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVEL (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE.	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50 % OF MATERIAL IS LARGER THAN NO. 200 SIEVE				SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE.	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND CLAY MIXTURES.
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
MORE THAN 50 % OF MATERIAL IS SMALLER THAN NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS.
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

GRAPH SYMBOL	LETTER SYMBOL	ROCK CLASSIFICATION
	SH	SHALE
	SI	SILTSTONE
	SS	SANDSTONE
	LS	LIMESTONE

PLASTICITY CHART



SWS SILICONES CORPORATION
ADRIAN, MICHIGAN

CLASSIFICATION CHARTS

FIGURE 4

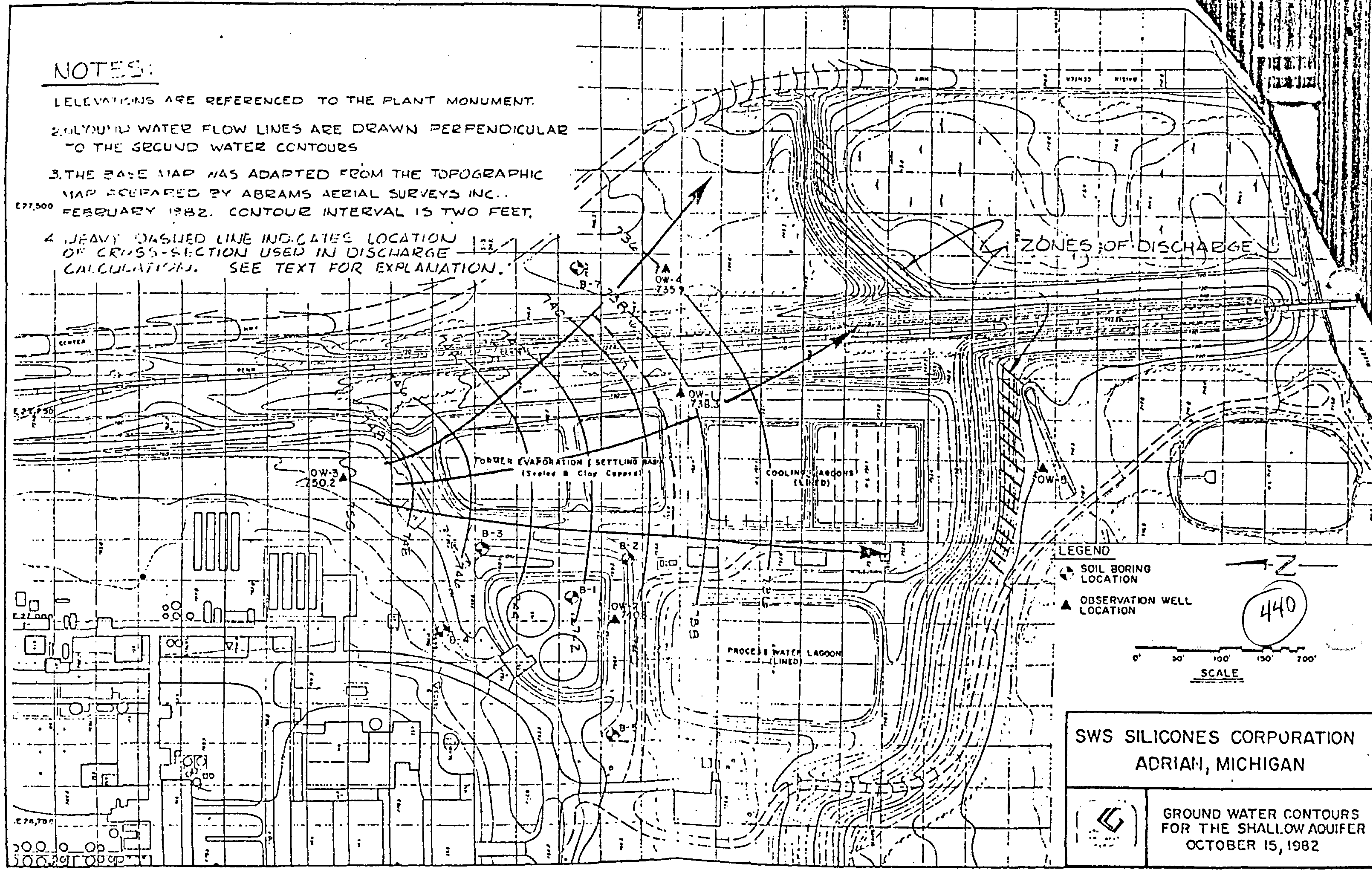

NOTES:
1. ELEVATIONS ARE REFERENCED TO THE PLANT MONUMENT.
2. GROUND WATER FLOW LINES ARE DRAWN PERPENDICULAR TO THE GROUND WATER CONTOURS
3. THE BASE MAP WAS ADAPTED FROM THE TOPOGRAPHIC MAP PREPARED BY ABRAMS AERIAL SURVEYS INC., FEBRUARY 1982. CONTOUR INTERVAL IS TWO FEET.
4. HEAVY DASHED LINE INDICATES LOCATION OF CROSS-SECTION USED IN DISCHARGE CALCULATION. SEE TEXT FOR EXPLANATION.
ZONES OF DISCHARGE
OW-4
735.9
OW-1
738.3
OW-3
750.2
OW-2
OW-5
B-1
B-2
B-3
B-4
B-5
B-7
FORMER EVAPORATION & SETTLING BASIN
(Sealed & Clay Capped)
COOLING LAGOONS
(LINED)
PROCESS WATER LAGOON
(LINED)
LEGEND
SOIL BORING LOCATION
OBSERVATION WELL LOCATION
440
0' 50' 100' 150' 200'
SCALE
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
GROUND WATER CONTOURS FOR THE SHALLOW AQUIFER
OCTOBER 15, 1982

FIGURE 5

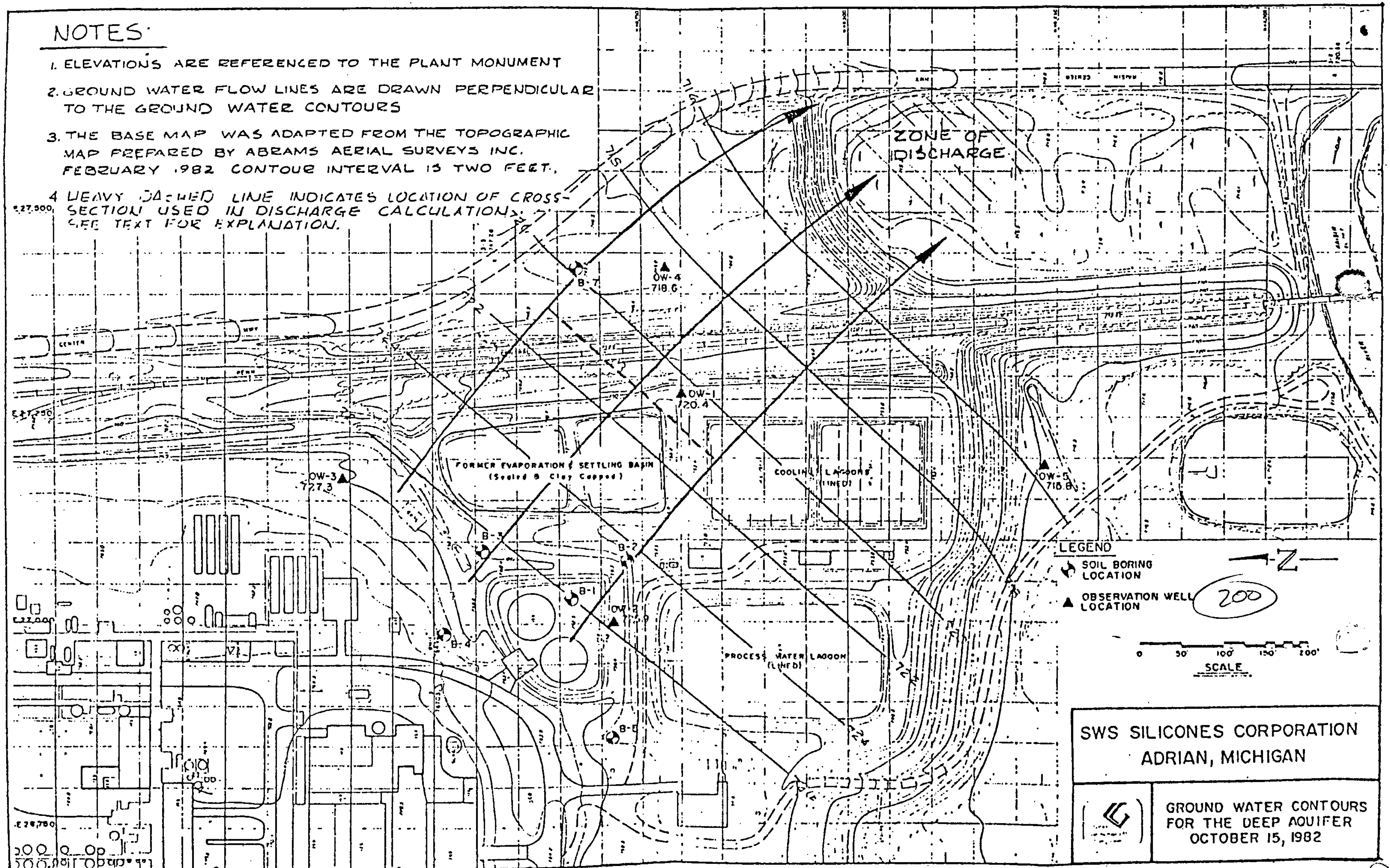

NOTES:
1. ELEVATIONS ARE REFERENCED TO THE PLANT MONUMENT
2. GROUND WATER FLOW LINES ARE DRAWN PERPENDICULAR TO THE GROUND WATER CONTOURS
3. THE BASE MAP WAS ADAPTED FROM THE TOPOGRAPHIC MAP PREPARED BY ABRAMS AERIAL SURVEYS INC. FEBRUARY 1982 CONTOUR INTERVAL IS TWO FEET.
4. HEAVY DASHED LINE INDICATES LOCATION OF CROSS-SECTION USED IN DISCHARGE CALCULATIONS. SEE TEXT FOR EXPLANATION.
ZONE OF DISCHARGE
OW-4
718.6
OW-1
720.4
OW-3
727.3
OW-5
718.8
B-7
B-3
B-2
B-1
B-4
FORMER EVAPORATION & SETTLING BASIN (Sealed & Clay Capped)
COOLING LAGOONS (LINED)
PROCESS WATER LAGOON (LINED)
LEGEND
SOIL BORING LOCATION
OBSERVATION WELL LOCATION
200
0 50' 100' 150' 200'
SCALE
N
SWS SILICONES CORPORATION
ADRIAN, MICHIGAN
GROUND WATER CONTOURS FOR THE DEEP AQUIFER
OCTOBER 15, 1982

FIGURE 6

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

Water Quality Division
9311 Groh Road
Grosse Ile, Michigan 48138

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

RECEIVED
NOV 12 1982
Groundwater Qual., WQD

November 9, 1982

Mr. Gordon Philbrook
Environmental Control Coordinator
SWS Silicones Corporation
Adrian, Michigan 49221

Dear Mr. Philbrook:

This letter will hopefully catch up with all the pending items we have with your facility.

Further to our letter of July 27, 1982, we are hereby approving the use of Nalco 354, Nalco 19, Nalco 7211, Nalco 7213 and Nalco 7220 at your facility at the usage rates indicated in your December 28, 1981 request. Additionally, based on our telephone conversation of November 8, 1982 regarding the usage rates and degradation of Nalco 7326 and 7320, we are approving the usage of these additives at the periodic slug dosage rates requested in your letter of January 22, 1982. Your October 12, 1982 request to use Nalco 7202 has been received and is currently under review.

Industrial Process Characterization Study

We have reviewed the information in your August 23, 1982 letter regarding the percent removal of ethyl silicate, Trimethoxyboroxine and Tetraethylorthotitanate and agree with your assumptions. These chemicals will not therefore be included in the final analytical list. The final analytical list agreed upon is that indicated as "Possible Contaminants of Interest" under part I. of your "Sampling Plan".

The sampling plan proposed does not address the sampling techniques nor the analytical methods you intend to use. This information must be supplied prior to our final approval. I would also suggest that your samples be collected on different days during the three week sampling period rather than all samples being collected on Wednesday. Additionally, our office would like to be notified at least two days prior to the time you collect samples so that we can split samples with you, if at all possible, on at least one occasion.

We have received your November 4, 1982 letter, regarding the biodegradability and toxicity data for Tergitol TMNIO, Triton X-45, Proxcel GXL, Atlox 1087 and Sulfanic N-150 and it is currently under review.

Lastly, many of the chemicals were deleted from the final analytical list based on assumed "percent removal" efficiencies across your treatment facilities. To verify these assumptions and to provide further credence to future use of these study results, we are requesting that the following sample locations be added to your sampling plan and that the samples be analyzed for styrene, cyclohexane and 1,1,1-trichloroethane:

1. Influent to wash water system
2. Effluent from wash water system to chemical sewer
3. Influent to chemical sewer treatment facility

While we understand the company position regarding "up the pipe" sampling expressed during our July 28, 1982 meeting, it appears to me that with all the effort that your facility has put into this study, verification of our basic assumptions so that the study results are usable in the future is warranted.

Hydrogeological Study

We have received your letter of September 10, 1982 with the information on the "old drum burial site" monitoring wells. Based on the analytical results shown in your report, we are requesting at least one additional sample from each well to determine what materials consitute the Total Organic Halogens and the Total Organic Carbon concentrations. There appears to be a significant increase between wells M-1, M-2 and well M-4 and further definition of these indicator parameters is necessary. Additionally, we would like you to calculate the flow volume of the affected groundwater table and furnish a projection of the anticipated spread through the ground from the possible source of contamination.

Hopefully, this letter has addressed all items we presently owe you a response on. If you have any questions regarding this letter, or if you are awaiting additional response from our office, please contact us.

Yours truly,

WATER QUALITY DIVISION

Roy E. Schrameck

Roy E. Schrameck, P.E.
District Engineer

RES/sc

cc: Bill Iversen
Jerry Saalfeld
Chang Bek
WQD files

INTEROFFICE COMMUNICATION

January 12, 1982

TO: Bob Babcock, Compliance Section

FROM: Wm. Iversen, Hydrogeology Unit, Groundwater Quality Section

SUBJECT: Phase II Hydrogeologic Study SWS Silicones Corp., Adrian, MI

I have reviewed the proposed phase II hydrogeologic study plan submitted January 5, 1982 for this facility. I have the following comments to offer:

1. The proposed study for the old drum burial site is fine as a generalized plan. However, it is not explained how down gradient wells will be sited nor the depths of sampling. If the wells are to be sited down gradient by actual field determination of groundwater flow direction with measurement of water levels, the plan may be suitable. To use an educated "guess" may miss any plume of contamination that has developed. The sampling depth is not spelled out. Are the wells to be completed at the water table or the bottom of the aquifer?

2. The parameters proposed to be sampled at the drum burial site are suitable as indicators with the possible addition of silicon. The waste disposal in the barrels was chlorosilanes which hydrolize to silicon compounds.

3. The proposed study of the perched and near surface aquifer in the vicinity of the black lagoon does not constitute determination of the impacts of the contamination on the groundwater or surface waters of the area. The study as proposed consists of monitoring additional parameters for better definition of contamination.

The company has maintained that the contamination is "insignificant" and could only effect the river. Because the single river testing has not shown the compounds in the river, the company states there is no significant impact.

No attempt has been made to determine the full contaminant loading to the river from the lagoon area over time nor the significance of this loading in addition to the loading from the permitted discharge. In addition closure of the lagoon will probably require additional geologic data on the continuity and thickness of the underlying clay to allow full encapsulation of the lagoon on site.

The permit calls for a hydrogeologic study to determine the impacts of past and present sources of contamination on the water resources of the state. The proposed phase II hydrogeologic study plan fails to address those potential impacts.

If you have any questions, please contact me.

WMI:ma
cc: R. Schrameck
C. Bek

JAN 07 1982

SWS Silicones Corporation

ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

RECEIVED
JAN 6 1982
Water Qual. Control

January 5, 1982

Mr. Robert J. Courchaine
Chief, Water Quality Division
Michigan Department of Natural Resources
P. O. Box 30028
Lansing, Michigan 48909

Re: SWS Silicones Corporation

Dear Mr. Courchaine:

This letter responds to Special Condition number six (6) of our recently renewed NPDES permit and is our proposal for certain additional hydrogeological work (Phase II) at our Adrian facility.

Special Condition number six refers to three investigative areas: (1) ground water contamination from buried barrels and sludge disposal area; (2) the extent of horizontal and vertical contamination in the perched aquifer and the extent of contamination in the lower aquifer; and (3) the impact of contaminants on the River Raisin.

1) Old drum burial site

We propose to drill groundwater monitoring wells around this site, one upgradient and three downgradient. We will analyze for copper and zinc, as well as the following parameters used as indicators of groundwater contamination under Section 265.92 of the federal RCRA rules (45 FR 33066, 33240, May 19, 1980) -

(i) PH;
(ii) Specific Conductance;
(iii) Total Organic Carbon;
(iv) Total Organic Halogen.

2) Study of Perched Aquifer and Near Surface Aquifer

We are prepared to resample our existing wells that are downgradient of the evaporation-settling (black) pond. The parameters to be sampled will include the original indicator parameters, TOC, chlorides, and methyl chloroform, as well as some pollutants which were detected in "significant" concentrations in the pond water, 1,1 dichloroethane (326 ppb), 1,2 dichloroethylene (229 ppb), and di-n-butyl phthalate (97 ppb). Since the parameters found in the pond water are few, the analysis of groundwater monitoring well samples should be similarly limited.

3) Study of the River Raisin

As you indicated in your March 5, 1981 letter, groundwater in both the perched and water table aquifers flow in a southeasterly direction to the river. Therefore, even if contamination were found in the

xc: R. Schumack
W. Townsend
C. Bek

perched and water table aquifers, that contamination would only impact the river. On April 23, 1981 we submitted to you sampling results for our river inlet, which is downgradient of the evaporation pond. Those sampling results, which include analysis of the 129 priority pollutants, show no significant contamination. We have also performed comparable analytical work on the river upstream of the pond, and that analytical work also shows no significant contamination. The results of these upstream samples were mailed to you on June 24, 1981. Further study of the river is unnecessary.

As required by the NPDES permit Schedule of Compliance, Part I, Section C.3.a, we must have an approved Phase II hydrogeological investigation plan on or before January 31, 1982. Therefore, we would appreciate a prompt reply to this proposal.

Please note that the above proposed plan is very similar to the one sent to Ms. Claudia Weaver from our Mr. Gary Ford on June 15, 1981.

Very truly yours,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 82-02, Certified

cc: L. B. Bruner
J. Calamungi
G. R. Wolf
G. L. Ford (Westport)
T. J. Sayers (Westport)
B. McClellan (Westport)
G. H. Meyer (Meyer and Kirk)
Ms. C. I. Weaver (DNR Enforcement Div.)

NPDES file

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

January 11, 1982

Mr. William Iversen
Geologist, Water Quality Division
Michigan Department of Natural Resources
P. O. Box 30028
Lansing, Michigan 48909

Dear Mr. Iversen:

This letter is to confirm our telephone conversation of January 8, 1982 concerning the Phase II hydrogeological work to be conducted at our Adrian site.

You said you would track down our letter to Mr. Robert Courchaine, dated January 5, 1982, and you would contact us within a few days concerning our proposed plan.

As explained to you, and stated in our letter, we must have an approved Phase II hydrogeological investigation plan, which is approved by the Chief of the Water Quality Division, on or before January 31, 1982.

Therefore, we would appreciate a prompt reply to our proposal.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:pb 82-10, Certified

cc: J. Calamungi
G. L. Ford (Westport)
B. McClellan (Westport)
T. J. Sayers (Westport)
G. H. Meyer (Meyer & Kirk, Detroit)

RECEIVED
JAN 14 1982
Groundwater Qual., WQD

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

Ms. Claudia I. Weaver
Environmental Enforcement Division
State of Michigan
Department of Natural Resources
Stevens T. Mason Building
Box 30028
Lansing, Michigan

Re: SWS Silicones Corp. - Adrian, Michigan

Dear Ms. Weaver:

This letter responds to your letter, dated June 1, 1981, and is our proposal for certain, limited additional hydrogeological work at our Adrian facility:

1) Old drum burial site

We propose to drill groundwater monitoring wells around this site, one upgradient and three downgradient. We will analyze for copper and zinc, as well as the following parameters used as indicators of groundwater contamination under Section 265.92 of the federal RCRA rules (45 FR 33066, 33240, May 19, 1980) -

(i) PH;
(ii) Specific Conductance;
(iii) Total Organic Carbon;
(iv) Total Organic Halogen.

2) Study of Perched Aquifer and Near Surface Aquifer

We cannot understand the State insistence that we engage in additional, costly and time-consuming monitoring of near surface groundwater which flows from the vicinity of the evaporation pond directly into the River Raisin. The State and SWS samples of pond contents show no significant contamination. The SWS samples of the river also show no significant contamination. As indicated in my April 6, 1981 letter to you, prompt authorization by the State to drain, close and cap the pond will better serve the goal of minimizing any leakage, than any additional hydrogeological work.

We are, however, prepared to resample our existing wells that are downgradient of the pond. The parameters to be sampled will include the original indicator parameters TOC, chlorides and methyl chloroform, as well as any pollutant which was detected in significant concentrations in the pond water. Results of the pond water sampling were sent to you by letter dated April 23, 1981. Since the parameters found in the pond water are few, the analysis of groundwater monitoring well samples should be similarly limited.

3) <u>Study of the River Raisin</u>

As you indicated in your March 5, 1981 letter, groundwater in both the perched and water table aquifers flow in a southeasterly direction to the river. Therefore, even if contamination were found in the perched and water table aquifers, that contamination would only impact the river. On April 23, 1981 we submitted to you sampling results for our river inlet, which is downgradient of the evaporation pond. Those sampling results, which include analysis of the 129 priority pollutants, show no significant contamination. We have also performed comparable analytical work on the river upstream of the pond, and that analytical work also shows no significant contamination. The results of these upstream samples will be mailed to you separately. Further study of the river is unnecessary.

In attempting to resolve the questions the State has raised, we have gone much further than we believe was required so that we could resolve this matter on an amicable basis. SWS has certainly acted in good faith by discontinuing the use of the evaporation pond, and by installing alternative, environmentally acceptable treatment facilities. It is still my hope that this matter may be resolved in an amicable way. After your receipt of this letter, please contact me to set up a meeting to discuss the acceptability of this plan, and a timetable for its implementation.

Sincerely,

Gary L. Ford

Gary L. Ford
Senior Attorney

GLF:mjz

cc: Dr. L. B. Bruner
Ralph Safford, Esq.
Meyer & Kirk

xc: Iverson
Schramecke
Babcock

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909
HOWARD A. TANNER Director

June 17, 1981

Mr. Gordon C. Philbrook
Environmental Control Coordinator
SWS Silicones Corporation
Adrian, Michigan 49221

Dear Mr. Philbrook:

I have received your June 8, 1981 letter with the attached data for the black pond sludge. According to your letter, you have determined the waste is non-hazardous by use of the EP-toxicity test. The EP-toxicity test, however, only evaluates one aspect of the sludge and, in the case of the type of sludge at SWS, is not sufficient to determine whether the waste is hazardous. Other characteristics of the waste also must be evaluated, as defined in Parts 2 and 3 of the Act 64 rules, to determine whether the sludge is hazardous. Results of our analyses of the black pond sediments (attached) and results of SWS's analyses of the lagoon wastewater indicate the sludge may contain organics which are listed in table 302(b) of Rule 302, Act 64. The presence of these organics in the sludge may classify the waste as hazardous.

Please complete the necessary analyses to determine whether the waste is hazardous by July 10, 1981. Upon completion of these analyses, the proper method of waste disposal and pond closure can be determined.

Please contact me at 517/373-3503 if you have any questions concerning this matter.

Sincerely,

Claudia I. Weaver

Claudia I. Weaver
Environmental Enforcement Division

CIW:sct
cc: Gary Ford, SWS Silicones
Babcock, Iversen, Grant,
Zollner, Zugger, Howard
Schrameck

R1026 1/80

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

RECEIVED
JUN 11 1981
ENVIRONMENTAL ENFORCEMENT
DIVISION

June 8, 1981

Ms. Caludia I. Weaver
Environmental Enforcement Division
State of Michigan
Department of Natural Resources
Stevens T. Mason Building
P.O. Box 30028
Lansing, Michigan 48909

Re: Your letter of June 1, 1981

Dear Ms. Weaver:

As per your letter of June 1, 1981, item 2, I am enclosing the laboratory data on the Black Pond sludge. This is non-hazardous as determined by the EPA RCRA and by the Michigan Act 64 definition of EP-Toxicity. We did not test for cycanide(s) or pesticides as we have no reason to believe these materials are present.

The leachate was prepared by our analytical laboratory personnel per the EPA "EP-Toxicity Test Procedure", and the metal analysis was done by Kemron Environmental Services of Farmington Hills, Michigan.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

81-131-GCP:jb
Attachment

Kemron®

Environmental Services
Borg-Warner Corporation
32740 Northwestern Highway, Farmington Hills, Michigan 48018 (313) 626-2426

Kemron Report No. 20903
Date 10-31-80

TO: SWS SILICONES CORPORATION
Attn: Mr. Burt Dennis
P. O. Box 428
ADRIAN, MI 49221

The following results were obtained on samples received on 10-29-80 and identified as shown.

TYPE OF SAMPLE: Water

ANALYSIS REQUESTED: Cu, Pb, Zn, Ni, Cr, Se, Co, Sb, Cd

KEMRON Lab No.	Your Identification Number	Name or Sample Description	Results of analysis
6585	47916 LEPS	Water sample	6.4 ppm Cu
	EVAPORATION (BLACK) POND SLUDGE LEACHATE		<0.1 ppm Pb
			2.9 ppm Zn
			0.22 ppm Ni
			<0.1 ppm Cr
			0.15 ppm Se
			<0.1 ppm Co
			<0.02 ppm Sb
			0.02 ppm Cd
	Addendum - 1/19/81		0.02 ppm As
			<0.01 ppm Hg
			<0.05 ppm Ag
			50 ppm Ba

L. Mavis
Analyst

Cecil L. Smith
Cecil L. Smith, Manager

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

June 1, 1981

Mr. Gary L. Ford
Senior Attorney
Stauffer Chemical Company
Westport, Connecticut 06880

Re: SWS Silicones Corp.
Adrian, Michigan

Dear Mr. Ford:

I have received your April 6, 1981 letter. Mr. Gordon Pilbrook also has submitted the revised plans for the waste-washes treatment system, the analytical data of samples from the black pond, outfall 001, and the river inlet and the EPA Consolidated Permit Application and Michigan Discharge Supplement. The purpose of this letter is to update you on the status of several issues at SWS.

1. Permit Application: The permit application package has been forwarded to Mr. Karl Zollner, Chief, Engineering and Technical Services. Mr. Zollner will review the application package for completeness and will send you a letter formally acknowledging receipt of the application. He also will coordinate development of a new permit. If you have any questions concerning permit development, please contact him. His telephone number is 517/373-8088.

2. Black Pond: In your April 6, 1981 letter, you stated that the sludge in the black pond had been determined to not be hazardous and you requested approval of the previously submitted closure plan. We cannot, however, determine the acceptability of this plan until you submit the results of the sludge analyses showing its chemical composition. Please submit this information by June 15, 1981.

3. Hydrogeological Study: Your April 6, 1981 letter takes the position that additional groundwater work is not necessary. We do not agree and we stand firm in our position that the additional work outlined in my March 5, 1981 letter is needed. The State is prepared to take formal enforcement action if SWS fails to proceed with the necessary studies and remedial actions. Therefore, I suggest SWS

expeditiously prepare and submit a proposal which addresses each of the four points stated in my previous letter.

4. Methyl Chloroform Effluent Limits: I have been informed by our Office of Toxic Materials Control that the procedures for setting permissible levels of methyl chloroform in discharges to surface waters have been revised. Use of these new procedures in the development of a new permit may result in a higher allowable level of methyl chloroform in SWS's discharge than had been determined previously. These limits will be determined upon receipt of your permit application.

5. Waste-Washes Treatment System: The revised plans for the waste-washes treatment system have been reviewed and approved. The Water Quality Division will send SWS a formal letter of plan approval.

As we discussed earlier, we can meet with you to discuss resolution of problems at SWS. However, I must impress on you the importance of SWS's immediately addressing points 2 and 3 above.

If you have any questions, please feel free to contact me at 517/373-3503.

Sincerely,

Claudia I. Weaver

Claudia I. Weaver
Environmental Enforcement Division

CIW:cf
cc: Zollner, Schrameck
Babcock, Iversen
Grant, Zugger, Bails
Gordon Philbrook

SHRADER
ANALYTICAL AND CONSULTING
LABORATORIES INC.
• Mass Spectrometry • Gas Chromatography • Supporting Services

April 29, 1981

Mr. Burt Dennis
SWS Silicones Corporation
P. O. Box 428
Adrian, Michigan 49221

Dear Mr. Dennis:

The volatiles analyses' data for the samples collected April 9-10 at the SWS Silicones plant site, including the chemical sewer, sanitary sewer, evaporation pond, and river sites, were reviewed for the presence of cyclohexane. No cyclohexane was detected. No quantitative standard was analyzed to set the detection limit; however, it is expected to be similar to that of the other volatile compounds.

Please let us know if we can be of further assistance.

Yours truly,

SHRADER ANALYTICAL &
CONSULTING LABORATORIES, INC.

John A. Defever

John A. Defever
Laboratory Manager

JAD/kal

3450 Lovett Avenue • Detroit, Michigan 48210 • (313) 894-4440

SWS Silicones Corporation

ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

April 6, 1981

Ms. Claudia I. Weaver
Environmental Enforcement Division
State of Michigan
Department of Natural Resources
Stevens T. Mason Building
Box 30028
Lansing, MI 48909

RECEIVED
APR 09 1981
ENVIRONMENTAL ENFORCEMENT DIVISION

Re: SWS Silicones Corp. Adrian, Michigan

Dear Ms. Weaver:

This letter is a reply on behalf of SWS to your letter, dated March 5, 1981 on the above-referenced matter. I will discuss each issue point by point as presented in the numbered paragraphs of your March 5, 1981 letter.

1. In this paragraph, you state that di-ethylhexylphthalate (DEHP) was detected at outfall 001 in the State's November 1980 Survey. You conclude that the discharge of DEHP is not authorized and constitutes a violation of SWS's NPDES permit and of Act 245. SWS would like to point out that we have never used DEHP as a raw material at our plant. Therefore, the fact that it is present in our effluent, in trace levels, is not a misrepresentation of our operations, and certainly no violation of Act 245. DEHP is widely used in this country as a plasticizer in a variety of products, including packaging, film, automobile upholstery, furniture, wall covering, clothing, and blood bags. Its presence in trace quantities at outfall 001 could be explained by any number of reasons, particularly since its presence in nature seems to be nearly ubiquitous. Most importantly, its detection could be the result of its presence as a plasticizer in wastewater sample bottles and other materials used in the course of sampling and analysis. While we are willing to discuss this matter with you, we reiterate that we do not use DEHP, and we cannot agree that its presence in outfall 001 is unpermitted or a violation of law. Results of follow-up sampling and analysis for DEHP will be submitted to you.

2. We are concerned that the State may not be honoring a commitment which we thought was reached at our July 2, 1980 meeting. Our notes of that meeting reflect that 1) Phase II of the hydrogeological survey would not be necessary unless the results of Phase I indicated there was "significant"

contamination of groundwater; and 2) a study of the old burial site need not be linked to a resolution of the evaporation pond issue or the issuance of an amended NPDES permit.

As to item 1), data in the September 16, 1980 Hydrogeological Study show that the evaporation pond is leaking only a minor amount of water into the perched system, and any leakage into the aquifer is extremely small. We do not believe those results support a conclusion that there is "significant" contamination. As indicated in that Study, prompt authorization by the State to drain, close and cap the pond will better serve the goal of minimizing any leakage, than any additional hydrogeological work.

Additional groundwater analyses are unnecessary, particularly since the State now agrees that the perched systems and aquifer flow into the river. We wish to remind you that it was our original contention, based on the Hydrogeological study, that the river, and not groundwater, was the proper focus of attention for any suspected contamination. The Hydrogeological Study showed no contamination of groundwater upgradient of the pond. The entities present in downgradient samples are presumably contributed by the pond or non-SWS sources. We note that the former county landfill is immediately adjacent to the plant. We have analyzed the pond waters for the 129 priority pollutants, and find nothing significant. We are willing to perform the analysis described in your paragraphs 3. and 4., below, on the river, and look forward to discussing this with you at our upcoming meeting.

As to item 2) above, the initial position taken by the State was that the old burial site was linked to the Notice of Violation, due to the transfer in the past of "sludge" from the pond to the old burial site. We have explained to Mr. Brian Reicks, in our letter dated August 29, 1980, that the sludge in the old burial site, consists of lime-neutralized silanes, and not methyl chloroform or other organics. We remain convinced that the site represents no problem. We believe the evaporation pond issues should be promptly addressed, and not linked to unrelated issues. In the interest of cooperation, we are willing to discuss the need for an appropriate groundwater sampling in the vicinity of the old burial site.

3. No comment is necessary.

4. A sampling program consistent with your paragraph 3, has been performed, and the results will be submitted to you. Please note that the analytical work was performed on the samples split with the State on September 9, 1980.

5.a. The analytical work conducted on our behalf detected no aliphatic amines in the pond water or at outfall 001. The sample taken by the State and categorized as Waste A was improcess wastewater having no direct relationship to any discharge points. This water may have contained aminofunctional silanes which we use in the manufacture of aminofunctional fluids. We suggest that the analysis obtained by the State may reflect the presence of these silane compounds, rather than any specific aliphatic amine.

We are confident that our waste wash water treating and our subsequent chemical sewer treating will remove these materials, so that the resulting discharge will be in compliance with the limits specified in our NPDES permit. We will endeavor to submit a statement of the adequacy of the wastewater treatment system by April 30, 1981.

b. We have determined that the sludge in the pond is not hazardous by federal RCRA and Act 64 regulations. We now request approval of our previously submitted closure plan.

6. The plant will submit a more detailed description of the waste-washes treatment system, which consists of above-ground steel tanks, including the methods for removal, handling and off-site disposal of sludges generated at the facility. We do not understand the rationale for requesting a PIPP (Pollution Incident Prevention Plan) revision, since the wash-water in the tanks are not a "polluting material" as defined by law. As you know, however, the tanks are placed on an impervious liner and are surrounded by diking.

7. We would like to renew our request for methyl chloroform limits of 2 ppm average, 5 ppm maximum, which the State has seemingly rejected. We assume that the proposed limits for methyl chloroform in your letter have, or are being, imposed on all other dischargers in the State. We feel we are entitled to a written explanation of the basis for the proposed limits.

Additional analytical data is being prepared by our outside lab. Upon receipt of such data, we will submit the EPA Consolidated Permit Application form and the Michigan Discharge Application Supplement.

We will contact you to arrange a meeting to hopefully resolve these matters.

Sincerely,

Gary L. Ford

Gary L. Ford
Senior Attorney

GLF:mjz

cc: Dr. L. B. Bruner
Randy Safford, Esq.

xc: Baldwin / Babcock
Iversen
Grant
Schrameck

STATE OF MICHIGAN

NATURAL RESOURCES COMMISSION
JACOB A. HOEFER
CARL T. JOHNSON
E.M. LAITALA
HILARY F. SNELL
HARRY H. WHITELEY
JOAN L. WOLFE
CHARLES G. YOUNGLOVE

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

RECEIVED
MAR 9 1981
Groundwater Comp, WQD

March 5, 1981

Mr. Gary L. Ford
Senior Attorney
Stauffer Chemical Company
Westport, Connecticut 06880

Re: SWS Silicones Corp.
Adrian, Michigan

Dear Mr. Ford:

This letter is in response to your September 11, 1980 letter and the September 26 and 29, 1980 plans submitted by Mr. Gordon Philbrook. This letter will summarize DNR staff's review of the plans and present our position on further corrective actions needed at SWS Silicones. I will discuss each issue point by point as presented in your September 11, 1980 letter.

1. It is our position that the discharge of methyl chloroform is not authorized by NPDES permit MI 0026034 and is unpermitted as stated in the February 5, 1980 Notice of Violation. SWS is, therefore, in violation of their permit and Act 245, PA 1929, as amended, and is subject to the penalties stated therein. Results of the November 1980 Industrial Wastewater Survey conducted at SWS confirm the on-going discharge of methyl chloroform through outfall 001. A copy of the survey report has previously been transmitted to SWS.

   Samples of outfall 001 collected during the survey also show the presence of di-ethylhexyl-phthalate (DEHP). Di-ethylhexyl-phthalate (or bis (2-ethylhexyl) phthalate) is an animal positive carcinogen and is an EPA priority pollutant. Although follow-up sampling and analysis is needed to verify the presence of DEHP in SWS's effluent, the discharge of DEHP also is not authorized and constitutes a violation of SWS's permit and of Act 245. Analyses for this contaminant are required in part 3 below.

2. The hydrogeological survey has not been completed, only Phase I. Additional hydrogeological work is needed as follows:

a. The study must be expanded to include the buried barrels, sludge disposal areas, and other possible sources of contamination on the property.

b. Data contained in the hydrogeological study submitted September 16, 1980, shows that the perched aquifer is contaminated. Additional hydrogeological study is needed to define the horizontal and vertical extent of the contamination in the perched aquifer. In addition, samples collected from a well located down-gradient of the lagoon indicate that contaminants are passing through the clay layer into the underlying aquifer. Additional hydrogeological work must be conducted to determine the extent of contamination in this lower aquifer.

c. Analysis of observation well data by staff indicates that groundwater in both the perched and water table aquifers flow in a southeasterly direction to the river. Therefore, study of the impacts of these contaminants on the river is necessary.

d. A more thorough analysis of groundwater samples from both aquifers is needed to determine the specific contaminants present.

SWS must perform a Phase II hydrogeological study to address the above items. The plan for this study must be reviewed and approved by DNR staff prior to initiation of the work. We request that this plan be submitted by April 15, 1981.

3. Contrary to your September 11, 1980 letter, SWS previously had agreed to perform a complete GC-MS analytical scan of samples from outfall 001 effluent and lagoon waste. This analysis is to include all EPA 129 priority pollutants (not just the volatile portion) and the Michigan Critical Materials styrene and dechlorane.

   We agree that analysis of outfall 002 effluent, which we understand consists only of sanitary sewage, is not necessary.

4. SWS has already been provided the parameter list (same as item 3 above) and sampling protocol for collection and analysis of samples from outfall 001 and the lagoon. Therefore, this sampling program should have been completed by now. We have yet to receive these sample results nor have we received SWS's results of samples from the lagoon and outfall 001 that were collected and split with the DNR on September 9, 1980. A copy of the results of DNR samples taken at that time are enclosed.

5. DNR staff have reviewed the proposals for diking the pond, treatment of the liquid lagoon wastes, and final closure of the lagoon.

   a. SWS was notified previously by the Water Quality Division that the diking plan was acceptable and I understand that the diking has been constructed. Before we can approve the proposed method of treating the liquid lagoon wastes, however, SWS must submit a complete analysis of the lagoon waste as specified in item 3 above. In addition to those analyses, the specific aliphatic amines that were detected in the September 9, 1980 waste samples collected by the Water Quality Division must be identified. SWS also must demonstrate that the wastewater treatment system can effectively treat and remove the contaminants and that the resulting discharge will be in compliance with the limits specified in their NPDES permit.

   b. Although we have received plans for closure of the lagoon, we cannot evaluate the adequacy of those plans until SWS determines whether the sludge is a hazardous waste. If the sludge is hazardous, it must be disposed of in accordance with Act 64, PA 1979.

   We request that a determination of the adequacy of the wastewater treatment system to treat the lagoon wastes and a determination of the proper method of lagoon sludge disposal be made by April 30, 1981. Upon making those determinations, SWS may be required to submit additional plans to address these problems. You are advised not to proceed with any portion of a lagoon closure plan until a comprehensive plan for closure is submitted to and approved by DNR staff.

6. Apparently, you have constructed and are using the waste-washes treatment system. Before we can approve the use of this system, you must submit a more detailed description of the system and methods for removal, handling, and disposing of sludges generated at the facility. You will also need to submit an amended PIPP (Pollution Incident Prevention Plan) to include the 400,000 gallon waste storage tanks. As part of this PIPP, the base and diking around these tanks must consist of an impervious material to contain any losses from the tanks.

7. Recommended NPDES permit limits for methyl chloroform and chlorides have been developed. The proposed limits for methyl chloroform are 0.70 ppm, 24 hour average, not to exceed 3.3 ppm at any time. The recommended chloride limits are 750 lb/day monthly average for summer and 1,000 lb/day monthly average for winter.

Before a final permit can be developed for SWS, however, an amended application using the EPA Consolidated Permit Application form and the Michigan Discharge Application Supplement must be submitted (forms are enclosed). These application forms will require SWS to specify the EPA priority pollutants and Michigan Critical Materials that are present in the facility's effluent. This application must be submitted by no later than April 15, 1981.

As you have requested, we can plan to meet with you to discuss further actions needed at SWS. At that time, we can also discuss the process characterization study that the Office of Toxic Materials Control has asked SWS to participate in. We encourage SWS to participate in this study since conducting a process characterization study will be required in their next NPDES permit. Prior to meeting with you, however, you must submit the data required in items 3 and 4 above and any additional information you have which will assist DNR staff in the evaluation and resolution of problems at your facility. This will enable us to review the data before the meeting and will expedite resolution of problems at the facility. Although we have had some preliminary discussions with the Attorney General's Office, we are still hopeful that this matter can be resolved short of formal enforcement proceedings.

Please contact me at 517/373-3503 to discuss any questions you may have and to arrange a meeting.

Sincerely,

Claudia I. Weaver

Claudia I. Weaver
Environmental Enforcement Division

CIW:sct
Enclosures
cc: Baldwin/Babcock
Schrameck
Iversen
Grant
Zugger
Zollner

RECEIVED

DEC 3 1980

Groundwater Comp, WQD

WMJ

December 1, 1980

TO: Robert Babcock, Surface Water Compliance Section

FROM: Larry Fink, Office of Toxic Materials Control

SUBJECT: Hydrogeological Survey and Lagoon Closure
SWS Silicones Corp., Adrian, Michigan

Based on the results of the Phase I hydrogeological survey conducted by SWS Silicones according to a protocol approved by William Iverson, Groundwater Compliance and Special Studies Section, it has been established that the evaporation lagoon seeped, resulting in the contamination of water beneath the pond with methylchloroform (1,1,1-trichloroethane). It is also likely that soils underlying the lagoon have become contaminated with substances historically discharged to the lagoon. To determine the identity and concentration of toxic pollutants potentially contaminating soils beneath the lagoon, we are recommending that samples of underlying soils be obtained; a leachate test performed on the soils according to RCRA protocols; and the leachate analyzed for the Section 307(a) toxic pollutants, the Critical Material styrene, and the halogenated fire retardants Dechlorane 5-10 and 604.

The proposed method of closure does not appear to meet the requirements of either Act 64 or RCRA. A determination should be made by the Office of Hazardous Waste Management as to whether the sludge in the lagoon is hazardous according to any Act 64 or RCRA criteria. At a minimum, it would appear appropriate to require some sort of underdrainage collection system and a monitoring well to establish that the lagoon is no longer a source of groundwater contamination, if the sludges are to be left on-site and the lagoon capped.

Should you have any questions, feel free to contact me.

LF/vls
cc: J. Grant/OTMC Files
V. Harris
R. Schrameck, District I
W. Iversen
C. Bek

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

RECEIVED
11-5-80 NOV 04 1980
WQC COMPLIANCE

TO: David Batchelor, EED

FROM: Tim Jaski, WQD
District One

Subject: SWS Silicones
Collection of Water &
Sludge Samples

DATE: October 27, 1980

On September 9, 1980, the writer and Water Quality Specialist Brian Reicks visited the SWS Silicones plant in Adrian. The purpose of the visit was to conduct a split sampling operation at several locations on the company's property. Before the sampling began, wemet briefly with Messrs. Calamungi and Philbrook as well as two men from the company's laboratory section. The parameters to be analyzed for from the collected samples were discussed.

The parameters are as follows:

Phenol	Nickel	Antimony	Aliphatic Amines	Toluene
Cadmium	Lead	Selenium	Styrene	Xylene
Chromium	Zinc	Dechlorane	Benzene	Methyl Chloroform
Copper	Cobalt	Aromatic Amines	Ethyl Benzene	Tetra-Chloro-Ethylene
				3,3 Di Chloro Benzene

The sampling points were determined to be as follows: (sketch attached)

Sample Station One : SWS Silicones NPDES Outfall 001
Water Sample only

Sample Station Two : SWS Silicones Settling/Evaporation Lagoon
(Black Pond) Composite Water & Sediments samples

Sample Station Three: SWS Silicones Water Intake at River Raisin
Water only

Sample Station Four: Waste Type A - Previously was discharged to
Black Pond
Liquid only

Sample Station Five: Waste Type B - Previously was discharged to
Black Pond
Liquid only

xc: To All who Rec'd data: C. Brk
9/9/80 L. Fink
B. Iversen

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

TO: David Batchelor
Environmental Enforcement Division

FROM: Roy Schrameck, District One
Water Quality Division

Re: SWS Silicones - Adrian
Correction Proposals

DATE: October 23, 1980

As requested by you at a meeting in Lansing on 10/22/80 the staff from the District One office are submitting their comments and recommendations regarding two proposals submitted by SWS Silicones.

PROPOSAL ONE: Waste-Washes Treatment System

a. We need the company's analysis results from split samples taken on 9/9/80.

b. The aliphatic amines found present in the "evaporation lagoon" need to be identified and quantified.

c. We would like to have a detailed engineering plan of the proposed batch treatment system including procedures, flow diagram, estimated daily loading, projected holding time, and a cross sectional plan of the tanks and their base.

d. Ultimate methods of removal, handling, transporting, manifesting and disposal of sludges generated in the treatment facility need to be defined.

e. Where in the system will separable constituents of waste water be removed (if planned) prior to discharge of treated waste wash water to the 001 treatment system ie. Methyl Chloroform.

PROPOSAL TWO: Closure of Evaporation-Settling Pond

a. We have no problem with the proposed diking to be located within the lagoon.

b. We need company's results of analysis of 129 priority pollutants for both the "evaporation lagoon" and outfall 001.

We need this in order to determine whether or not the 10,000 gal. per day discharge from the lagoon will be truly amenable to treatment in the 001 system and meet permit limits upon discharge. Based on current information the company won't have trouble with Methyl Chloroform and Chlorides but we're in the dark regarding Aliphatic Amines and the 129 Priority Pollutants.

c. We want the company to convert the sludge into a truly stabilized sludge that won't leach in the future. This would be demonstrated prior to implementation by running a bench test for leachability under projected compression and compaction pressures.

d. Both the fill and the clay cap should be compacted to 10^{-7} cm/sec.

e. Is the existing dike to be modified in accordance with "pond" cover's slope?

f. Soil erosion control measures should be employed until ground cover vegetation is established.

We have some miscellaneous comments to add before closing out this memo.

1. Regarding the Hydrogeological Study: we are concerned about the fact that the perched water table (which is receiving leachate from the pond) is connected geologically to the River Raisin. This further argues for stabilizing the pond's sludge.

2. We have not received the analyses for the samples taken from the borings during the hydrogeological study.

3. The monitoring wells don't seem to be in adequate locations to quickly intercept migration of contaminants from the pond after it is closed.

4. We feel that the diking material around the two 400,000 gallon tanks should be clay that can be compacted to 10^{-7} cm. Also the floor of the diked area should be made impervious with necessary controlled drainage.

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

RECEIVED
OCT 23 1980
Groundwater Comp, WQD

WQ file

October 21, 1980

TO: Robert Babcock, NPDES Compliance
Water Quality Division

FROM: David Batchelor, Permit Enforcement
Environmental Enforcement Division

SUBJECT: SWS Silicones
Adrian

As previously requested and discussed, please prepare and forward a Water Quality Division position regarding correspondence received from SWS after our letter of August 29, 1980; and, a determination regarding: the acceptability of the proposed plans to remove, treat and dispose of lagoon contents; an evaluation of the hydrogeological report; modifications to the facility PIPP; and, comments on the proposed Waste Waters Treatment System.

Upon receipt, I will schedule a staff meeting; and, subsequently a meeting with the company.

DJB:dr

cc: C. Bek
R. Schrameck
F. Baldwin
J. Saafeld/L. Fink
W. Iversen
P. Zugger

MICHIGAN DEPARTMENT OF NATURAL RESOURCES W. Iversen

INTEROFFICE COMMUNICATION

October 15, 1980

RECEIVED

OCT 16 1980

Groundwater Comp, WQD

TO: Roy Schrameck

FROM: Bob Babcock Bab

SUBJECT: SWS Silicones

As per Dave Batchelor's memo of September 4, 1980, I am responsible for coordinating and developing the Water Quality Division statements with regard to the position of our Division with SWS Silicones Company. The matters of review are the following:

1. Acceptability of batch wastewater treatment plans
2. Acceptability of Black Pond Closure Plans
3. Acceptability of PIP Plans
4. NPDES Permit Status

Please have prepared your comments and review of these and all submittals and analytical data from September 9, 1980 sampling with regard to this Company so that we may meet on Wednesday morning at 10:00 in the 7th Floor Conference Room of the Mason Building on October 22.

If you have any questions or comments about the proposed meeting, please do not hesitate to contact me at 38448.

clp

cc: T. Jaski
C. Bek
L. Fink
D. Batchelor
F. Baldwin
S. Ross
W. Iversen (Note: Although you are not available, I'll need your comments on the Phase I of the hydrogeological study, and, direction for subsequent work.)

Stauffer
Stauffer Chemical Company
Westport, Connecticut 06880 / Tel. (203) 222-3000 / Cable "Staufchem"

September 16, 1980

Mr. William Iversen
Chief Geologist
Water Quality Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, Michigan 48909

RECEIVED
SEP 19 1980
Groundwater Comp, WQD

Dear Mr. Iversen:

As discussed in your letter of June 16, 1980, we have completed our investigation of geologic and ground water conditions in the vicinity of the evaporation pond at the SWS facility in Adrian. The nature of the hydrogeology encountered, i.e., the extensive clay layer 15 to 25 feet below grade and the presence of a perched ground water body above this clay layer, was different than envisioned when we outlined our original investigation proposal. Because of this, the well cluster configurations were modified so that at each point where clay was encountered, both the perched and actual ground water bodies could be sampled.

The attached report by Commonwealth Associates, Inc., "Hydrogeologic Study for Evaporation and Settling Basin", includes descriptions of the drilling methods used, the geologic conditions at the site, and water table contour maps for both the perched and true water tables. Some permeability data has also been developed from shelby tube analyses. These show that the clay has a permeability of 1 X 10^{-7} cm/sec. and that the silt above the clay has a permeability of about 10^{-5} cm/sec. From measured gradients, it can thus be calculated that ground water flow rate in the silt layer is about 7 ft/yr.

Also attached are the results of the requested analyses of ground water samples. These analyses were run at the SWS laboratory. They should be viewed as indicator analyses only and are not intended to fully characterize either the water in the pond or the ground water. Other organics are also present in some of the samples.

Based on these results, it appears that the evaporation pond is leaking only a minor amount of water into the perched system. Flow in the perched system is very slow and any leakage into the aquifer is probably extremely small. Removal of all water coupled with sludge fixation and sealing the top of the evaporation pond in such a manner as to prevent infiltration of rainfall, and continued monitoring of the 9 test wells would seem to be appropriate based on these findings.

Very truly yours,

Paul H. Roux
Senior Hydrogeologist

PHR/ach
Attachments
cc: Mr. David J. Batchelor (with attachments)
Mr. L. Bruner

SWS SILICONES, ADRIAN, MI.

INDICATOR ANALYSES RESULTS

SAMPLE	DEPTH BELOW LAND SURFACE (FEET)	DATE SAMPLED	CHLORIDES (PPM)	TOC (mg/l)	METHYLCHLOROFORM (PPM)
Evaporation Pond	--	8/5	2100	--	5
Well 1S[1)]	12	8/8	4700	3600*	18
Well 1D[2)]	32	8/8	1182	18	N.D.
Well 2S	14	8/8	191	12	N.D.
Well 2D	30	8/8	152	6	N.D.
Well 3S	11	8/8	623	15	N.D.
Well 3D	37	8/8	265	4	N.D.
Well 4S	8	8/8	1390	44	N.D.
Well 4D	29	8/8	301	7	N.D.
Well 5	6	8/8	453	23	N.D.
Evaporation Pond	--	8/25	2024	600	4.5
Well 1S	12	8/25	375	320	17

*result is not reasonable, resampled and analyzed on 8/25, see new result above.

Detection limit for methylchloroform 0.04 ppm

1) S - Suffix wells tap only perched ground water above the shallow aquifer.
2) D - Suffix wells tap the shallow aquifer.

Note: Well locations and descriptions are given the in the report "Hydrogeologic Study for Evaporation and Settling Basin" by Gilbert/Commonwealth.

RECEIVED

Stauffer CHEMICALS

Stauffer Chemical Company

Westport, Connecticut 06880 / Tel. (203) 222-3000 / Cable "Stauchem"

SEP 17 1980

ENVIRONMENTAL ENFORCEMENT DIVISION

September 11, 1980

David J. Batchelor, Esq.
Resource Specialist
Environmental Enforcement Division
State of Michigan
Department of Natural Resources
Stevens T. Mason Building
Box 30028
Lansing, Michigan 48909

Re: Notice of Violation
2/5/80 - NPDES Permit
No. MI 0026034

Dear Mr. Batchelor:

This letter is responsive to your letter to Mr. J. Calamungi, dated August 29, 1980, and the telephone conversation between T. Sayers and G. Ford, Stauffer Chemical Company, and yourself, held on September 3, 1980. The purpose of this letter is to set forth our understanding of the current status of this matter, and SWS Silicones Corporation's (The Company) position on certain issues, as follows:

1. As represented by Mr. G. Philbrook, the Company has eliminated the methyl chloroform discharge into the evaporation pond, but has not eliminated the discharge at outfall 001. Methyl chloroform is a very minor constituent of the process water treated for discharge at outfall 001. Total elimination would require cessation of all discharge and result in plant shut down. Methyl chloroform is not regulated in any known Michigan issued NPDES permit and a demand for cessation of discharge is inconsistent with our ongoing negotiations for an acceptable NPDES permit limitation for methyl chloroform at outfall 001.

2. The approved hydrogeological survey has been completed, and the results will be presented to the State by September 19, 1980. That survey includes soil borings, ground water flow patterns and sampling and analysis for the agreed upon indicator parameters TOC, chlorides, and methyl chloroform.

3. As reiterated in the 9/3/80 telephone conversation with Messrs Sayers and Ford, the State requested an analysis of the evaporation pond and the discharge from outfall 001. The analysis will be limited to the volatiles portion of the EPA 129 priority pollutants (using GC/MS), as well as the Michigan Critical Material styrene, and dechlorane.

   As discussed in the 9/3/80 telephone conversation, we believe an agreement was made that no analysis of outfall 002 is necessary. The effluent discharged from this outfall is sanitary waste from a sanitary package unit, and does not contain process waste. Our notes of the May 2, 1980 meeting with DNR reflect that understanding.

4. The results of the pond and outfall 001 sampling will not be available in September. Analysis of the pond and 001 could not commence until the DNR indicated the pollutants of concern for analysis. The sampling of the pond could not commence until a sampling protocal was agreed upon. It is our understanding that representatives of DNR and the Office of Toxic Substances will visit the plant on 9/9/80 to discuss the sampling protocol. Samples will be taken by the DNR and split with the Company at that time.

5. We will provide to you by September 30 a proposed corrective program and schedule for the removal and proper disposal of the pond contents, as follows:

   (a) We propose to transfer the supernatant waters in the pond to the NPDES treatment system for further treatment and discharge through outfall 001. This action will be commenced promptly after DNR approval. Water diverted from the pond and presently stored in above ground tanks will be treated in the batch pre-treatment tank system now under construction and will then pass through the NPDES treatment system.

(b) We will provide to you by September 30 a proposed closure plan for the pond site. This plan will involve the in situ closure of the pond after the liquid phase has been removed and disposed of as set forth in 5(a) above. The closure plan will set forth procedures for fixation of sludge, filling and grading, for clay capping the site, and for top soil and seed. The plan will also address the need for, frequency of and time period for ground-water monitoring in the vicinity of the pond, to assure that no substantial leachate is generated.

6. We will provide to you by September 30, the plans for the above ground tanks, to be used as the alternate storage and treatment facility for the pond waters, including the proposal to discharge these waters from the tanks through outfall 001.

7. It is our understanding that a formal determination on NPDES permit limits for methyl chloroform and chlorides will be provided by the Water Quality Division staff in the near future.

8. After receipt and review by you of the above-referenced information, a meeting in early October will be scheduled between the Company and DNR.

Pursuant to the 9/3/80 telephone conversation, it is our understanding that in lieu of an amended NPDES permit application, the foregoing agreements, including a description of the above ground tanks, may be formalized into an administrative Board order, which will include a comprehensive program and schedule to correct all outstanding regulatory concerns and water quality concerns.

Sincerely,

SWS SILICONES CORPORATION

By Gary L. Ford
Gary L. Ford
Senior Attorney

GLF:kfk

cc: George H. Meyer, Esq.

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

L. Bruner
B. Dennis
G. Philbrook
T. Sayers - Westpor
G. Wolf

September 9, 1980

RECEIVED
SEP 15 1980
ENVIRONMENTAL ENFORCEMENT DIVISION

Michigan Department of Natural Resources
District 1, PTE. Mouillee State Game Area
Route 2, 37205 Mouillee Road
Rockwood, MI 48173

ATTENTION: Mr. Tim Jaski
Mr. Brian Reicks

Gentlemen:

Confirming our discussion on the above date, I wish to re-emphasize that the waste samples requested and taken from our waste storage tanks, represent process wastes, which in no way will reflect what will eventually be discharged to our effluent stream. As stated, this material will be treated and tested before discharge to outfall 001. The final effluent from the treatment ponds will meet the limits agreed upon in the proposed NPDES permit.

If there are any questions regarding the above, please contact me.

Sincerely,

SWS SILICONES CORPORATION

Joseph Calamungi

Joseph Calamungi
Director of Manufacturing

JC:df

CERTIFIED

District I WQD

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

August 29, 1980

Mr. J. Calamungi, Director
SWS Silicones Corporation
P. O. Box 428
Adrian, Michigan 49221

Re: Notice of Violation 2/5/80
NPDES Permit No. MI 0026034

Dear Mr. Calamungi:

This letter summarizes the current status of compliance with the terms of the February 5, 1980 Notice of violation; and, provides a response to the corporate letter of July 31, 1980, regarding NPDES Permit No. MI 0026034 effluent limitations.

During an August 19, 1980 phone conversation, Mr. Gordon Philbrook represented that the company had eliminated all discharges of wastes into the seepage lagoon; but, had not eliminated the methyl chloroform (1,1,1-trichloroethane) discharge at outfall 001. Mr. Philbrook also indicated that Phase I of the approved hydrogeological survey had been completed and ~~that~~ analyses therefrom would be made available to the Department by early to mid-September. The gas chromatograph/mass spectrometric (GC/MS) characterization of seepage pond contents and outfalls 001 and 002 was also discussed. It is my understanding that the results of these samples would also be completed and submitted to the Department in September. If the above does not reflect the current status or the company's position, this office should be notified immediately.

Finally, the Department has not yet received a proposed corrective program and schedule for the removal and proper disposal of contaminated lagoon contents.

In a letter of July 31, 1980, the company agreed to analyze for and accept the limitation of methyl chloroform under NPDES permit; however, the limitations proposed by the Department were felt to be unreasonably low. Suggested chloride loading limitations were also presented for consideration by the Department.

MICHIGAN
THE GREAT LAKE STATE

SEP 2 1980
PTE. MOUILLEE S.G.A

The company's requested limitations for methyl chloroform and chlorides are under review. Some relief on the methyl chloroform limits may be appropriate. A formal determination on this issue will be provided by Water Quality Division staff in the near future.

It is the position of the Department that the following information must be submitted to consider the company's application for reissuance of NPDES permit complete:

1. GC/MS characterization of lagoon contents and outfall 001 and 002 effluents for the EPA 129 Priority Pollutants; the Michigan Critical Material styrene; and, dechlorane;

2. The results of Phase I of the hydrogeological survey;

3. A program and schedule for removal and proper disposal of contaminants from the seepage lagoon; and,

4. Submission of an amended NPDES application (federal and state forms enclosed) for increased use resulting from a discharge of treated wastewaters from the proposed batch treatment system.

This information should be submitted on or before September 30, 1980. Failure of the company to submit this information will result in the Department initiating escalated enforcement action. Upon receipt of the above, Department staff can proceed with development of an NPDES permit and/or administrative order which would include a comprehensive program and schedule to correct all outstanding violations and water quality concerns.

If you have any questions, feel free to contact my office (517) 373-3503.

Sincerely,

David J. Batchelor
Resource Specialist
ENVIRONMENTAL ENFORCEMENT DIVISION

DJB:ca
Encl.
cc: G. Meyers, Esquire
G. Philbrook
T. Sayers
R. Courchaine
F. Baldwin/B. Babcock
K. Zollner/C. Bek
R. Schrameck/B. Ricks
J. Bails/J. Miller
J. Saalfeld/L. Fink

SWS Silicones Corporation
ADRIAN, MICHIGAN 49221 • TELEPHONE (517) 263-5711

July 31, 1980

Mr. Tim Jaski
State of Michigan
Department of Natural Resources
District #1 Engineer
Water Quality Division
Pte. Mouillee State Game Area
Route #2
Rockwood, Michigan 48173

Re: Waste Treatment Tanks

Dear Mr. Jaski:

This is to confirm our telephone conversation of Tuesday, July 29, 1980, concerning the installation of the two 400,000 gallon waste treating tanks at our facilities here in Adrian.

As you know, we are installing the treating tanks in order to eliminate the usage of the evaporation (settling) pond and to allow closing of this pond.

As agreed, we are installing the two treating tanks as per accepted construction practice for large API tanks. There will be six inches deep of oil-impregnated-sand under each tank, in order to allow proper support of the tanks. The tanks are being installed on a clay layer, with a five foot deep ring-wall foundation.

Yours truly,

SWS SILICONES CORPORATION

Gordon C. Philbrook

Gordon C. Philbrook
Environmental Control Coordinator

GCP:jb

xc: John Bohunsky / WQD files
Scott Ross

xc: D. Batchelor
R. Babcock
C. Bek
W. Iversen
L. Fink

Stauffer CHEMICALS

Stauffer Chemical Company

Westport, Connecticut 06880 / Tel. (203) 222-3000 / Cable "Staufchem"

JUN 2 1

May 28, 1980

RECEIVED
GEOLOGICAL SURVEY DIV.
JUN 2 1980
AM 7 8 9 10 11 12 1 2 3 4 5 6 PM

William Iversen
Geologist
Water Quality Division
Michigan Department of Natural Resources
P.O. Box 3002B
Lansing, Michigan 48909

Dear Mr. Iversen:

As you requested, I am sending a proposal for an investigation of ground-water condition around the evaporation pond at the SWS Silicones plant in Adrian. The well installations can begin shortly after we receive your comments on the proposed program.

Very truly yours,

Paul H. Roux/ach
Paul H. Roux
Senior Hydrogeologist

PHR/ach
Attachment

PROPOSED INVESTIGATION OF GROUND WATER CONDITIONS

AROUND THE EVAPORATION POND

The plant presently operates a small (approximately 100 by 200 feet) evaporation pond for the disposal of liquid wastes. The pond has no artificial liner, however, the build-up of sludge has probably sealed the bottom and has the effect of restricting leakage.

The types of sediments directly underlying the pond are not known. For example, there may or may not be a thin clay layer directly under the pond. Generally, however, well logs from nearby show a sand layer about 70 feet thick which is underlain by a 50 foot thick layer of clay.

The proposed investigation is designed to answer the following questions:

1. Geology under the pond.

2. Depth to the water table.

3. Direction of ground water flow under the pond.

4. Influence of the pond on water quality in the underlying sediments.

To answer these questions, the following tasks will be undertaken:

1. Drill approximately six test wells in the vicinity of the pond. Tentative locations are shown on the attached map. The wells will be 2-inch diameter PVC casings screened from the water table to 10 feet below the water table.

2. The drill cuttings will be logged to establish the types of sediments under the pond.

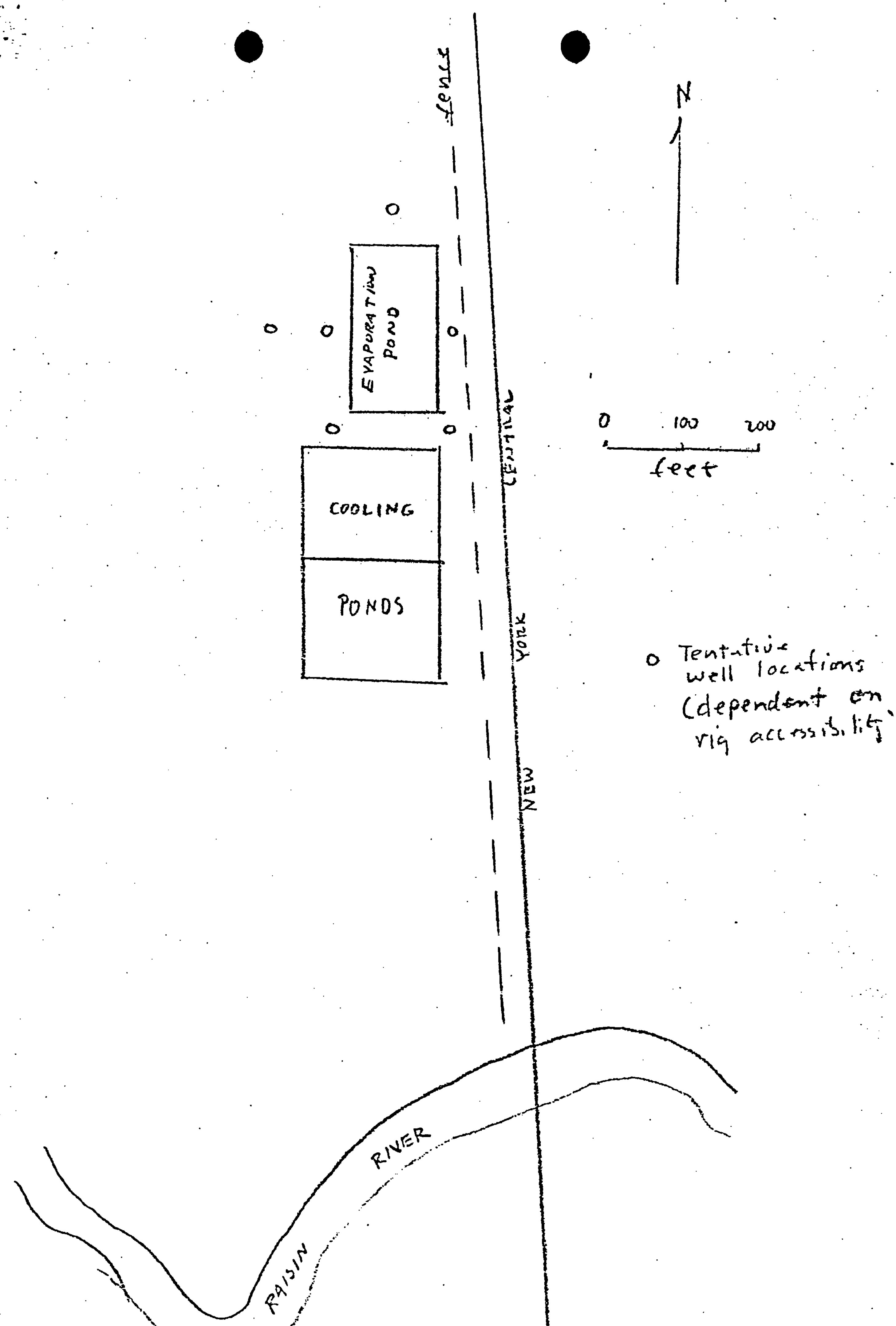
3. Water levels in the wells will be leveled to a common datum to determine the local gradients and flow directions.

4. Water samples will be collected from each well and analyzed for chlorides and methyl chloroform.

5. Based on the results of the above tasks, three locations will be selected for well clusters, 2 downgradient and 1 upgradient of the pond. At each of these sites, two wells will be drilled in addition to the shallow well already in place. One of these additional wells will be screened over a 10 foot interval at the bottom of the sand unit underlying the pond, and the second well will be screened over a 10 foot interval near the center of the sand unit.

6. A sample will be collected from each new well in each of the three clusters (a total of six wells) and analyzed for chlorides and methyl chloroform.

The data obtained from the above six tasks will be interpreted to determine if the pond is leaking significant concentrations of contaminants into the ground water and, if so, what additional investigation and/or remedial work is required.


fence
N
EVAPORATION POND
CENTRAL
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feet
COOLING
PONDS
YORK
o Tentative well locations (dependent on rig accessibility)
NEW
RAISIN RIVER

Mr. Iversen

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

May 19, 1980

Ralph R. Safford
Meyer and Kirk
100 W. Long Lake Road, Suite 100
Bloomfield Hills, MI 48013

Re: SWS Silicones Corporation
Adrian, Michigan

Dear Mr. Safford:

This is in response to your personal delivery of SWS Silicones Corporation materials with Mr. Gordon Philbrook on May 14, 1980 in which you requested some of these materials be deemed confidential. Pursuant to Section 13 of Act 442 of the Public Acts of 1976 (being Section 15.243 of the Michigan Compiled Laws), the Freedom of Information Act, item #1 identified as "current list of SWS raw materials used in manufacturing", hereinafter item #1, dated 5/9/80, is accepted as confidential information. However, the following materials which were received on May 14, 1980, have been determined to not require handling as confidential (using the numbers as they were submitted):

item 3. Report of Soil Testing Borings, Detroit Testing Laboratory (May 12, 1964)

item 3a. 2 drawings: - one contour drawing showing well locations, and, - one well log drawing

item 4. description of SWS water treatment proposal dated 5/12/80 with two (2) sketches with 2 brochures and drawing #0-145 (site plan)

item 5. Drawing showing current well logs (4/80)

Item #1 will be maintained within locked files and access limited to the appropriate authorized personnel only. Upon completion of the review and our use, item #1 will be returned to SWS Silicones Corporation.

If you have any questions or comments, please feel free to contact Mr. Robert Babcock of my staff (517) 373-8448.

Sincerely,

WATER QUALITY DIVISION

Robert J. Courchaine

Robert J. Courchaine
Division Chief

RJC:RB:ma
cc: G. Philbrook
R. Schrameck
F. Baldwin
J. Miller
L. Fink
T. Schimpf

MICHIGAN
THE GREAT LAKE STATE
R1026 1/79